



The algorithm's mercy

Two new books explore the upside of big data and AI

They are a refreshing counterbalance to alarmist commentary

The Equality Machine. By Orly Lobel. PublicAffairs; 368 pages; \$30 and £25

Escape from Model Land. By Erica Thompson. Basic Books; 256 pages; \$30 and £20

TWO YEARS ago, when Elinor Lobel was 16, a “smart” insulin pump was attached to her body. Powered by artificial intelligence (AI), it tracks her glucose levels and administers the right dose of insulin at the right time to keep her healthy. It is a miraculous innovation for diabetes sufferers and just one of myriad new ways that data and AI can help improve lives.

Books that decry the dark side of data abound. With menacing titles such as “Weapons of Math Destruction” and “Algorithms of Oppression”, they suggest that there is much more to fear than fete in the algorithmic age. The public is duly alarmed; ditto policymakers. For instance, a proposed European Union directive may hold back some educational applications of AI, such as its use in marking exams.

But the intellectual tide may be turning. One of the most persuasive proponents of a more balanced view is Elinor Lobel’s mother, Orly, a law professor at the University of San Diego. In “The Equality Machine” she acknowledges AI’s capacity to produce skewed and harmful results. But she shows how, in the right hands, it can also be used to combat inequality and discrimination. “We need to cut through the utopian/dystopian dualism,” she writes. “The goal should be progress, not perfection.”

For example, women selling goods on eBay tend to receive less money than

men for the same item. Apprised of that bias, the website can hide vendors' personal details until an offer is made, or alert them to higher prices in similar transactions. Meanwhile women looking for jobs are less likely than men to respond to postings that use military jargon such as "mission critical" and "hero". Textio, an AI firm, helps companies recruit female employees by scanning listings and recommending alternative language.

"The Equality Machine" buzzes with such examples, revealing a hidden world of coders, data scientists and activists who are working on the technical means to achieve ethical ends, not simply griping about AI's lapses. The book aptly describes the workings of various AI systems, but its main contribution is to reframe problems in constructive ways.

A tenet of privacy rules is "minimisation": collect and retain as little information as possible, especially in areas such as race, gender and sexual orientation. Ms Lobel flips the script, showing how in countless cases of medical diagnosis and treatment, as well as in hiring, pay and the legal system, knowing such characteristics can lead to fairer outcomes. For example, in the past American regulators did not track the performance of medical devices by the sex of patients, though an independent study suggested women experience twice as many deaths and injuries as men.

Ms Lobel's call to use more, not less, personal information challenges data-privacy orthodoxy. But she insists that "tracking differences is key to detecting disparities." She advocates a careful loosening of intellectual-property rules to provide more transparency over algorithmic decisions. And she floats the idea of a sort of affirmative action in AI to support disadvantaged groups. For instance, an algorithm that serves adverts for highly paid jobs to men—because they mostly clinched such posts in the past—can be programmed to show them equally to women.

As Ms Lobel says, AI need not merely reproduce or entrench old biases. It

can help expose them. And it is easier to fix an algorithm than it is to change people's minds.

The problems with algorithmic formulae are tackled in depth in "Escape from Model Land" by Erica Thompson of the London School of Economics. These statistical models are the backbone of big data and AI: if data is the input, algorithms are the tool and models are the product. They are everywhere, from e-commerce tips to economic and climate-change forecasts.

Yet rather like the full-scale map of an empire imagined by the writer Jorge Luis Borges, a perfect model of the teeming world will always be beyond reach. The task is to ensure that the abstractions correspond to reality as far as is humanly possible. "All models are wrong," runs a venerable saying. "Some are useful."

| *Model students*

Ms Thompson focuses on a challenge she calls the Hawkmoth Effect. In the better known Butterfly Effect, a serviceable model becomes less reliable over time because of the complexity of what it is simulating, or because of inaccuracies in the original data. In the case of climate change, say, this might lead to a prediction for rising temperatures being out by a fraction of a degree. In the Hawkmoth Effect, by contrast, the model itself is flawed; it might fail to take full account of the interplay between humidity, wind and temperature. This sort of mistake can be much more misleading, and much harder to rectify.

The author calls on data geeks to improve their solutions to real-world issues, not merely refine their formulae—in other words, to escape from model land. "We do not need to have the best possible answer," she writes, "only a reasonable one." Before there is a statistical model, she notes, there is a mental version. Data scientists need self-awareness and empathy as

well as mathematical skill.

Both these books exhibit a healthy realism about data, algorithms and their limitations. Both recognise that making progress involves accepting constraints, whether in law or coding. Ms Lobel calls on AI practitioners to remedy the technology's problems; Ms Thompson asks data scientists to be conscious of the choices and values in a model's design. Their reflections offer the basis for a constructive agenda. As Ms Lobel puts it: "It's always better to light a candle than to curse the darkness." ■



算法的恩惠

两本新书探究大数据和人工智能的光明一面

平衡危言耸听论调的观点令人耳目一新【《平等机器》、《逃离模型世界》书评】

《平等机器》，奥利·洛贝尔著。PublicAffairs出版社，368页；30美元/25英镑。

《逃离模型世界》，埃里卡·汤普森著。Basic Books出版社，256页；30美元/20英镑。

两年前，当时16岁的埃莉诺·洛贝尔（Elinor Lobel）在身上装了一个“智能”胰岛素泵。依靠人工智能（AI）的驱动，它可以监测血糖水平，并在合适时间为她注射合适剂量的胰岛素，让她保持健康。对于糖尿病患者来说，这是一项不可思议的创新，而这只是数据和AI助力改善生活的无限可能中的一例。

抨击数据黑暗面的书籍比比皆是。它们有着耸人听闻的书名，例如《数学杀伤性武器》（Weapons of Math Destruction）和《算法压迫》（Algorithms of Oppression）。它们指出，在算法时代，畏惧要远多于欣喜。公众戒心大增，政策制定者也如临大敌。例如，欧盟正在拟议一项指令，可能会限制AI在教育中的一些应用，比如为考试评分。

但这股思潮可能正在转向。有些人很有说服力地提出了一种更加平衡的观点，其中之一就是埃莉诺的母亲、圣地亚哥大学的法学教授奥利·洛贝尔（Orly Lobel）。在《平等机器》（The Equality Machine）一书中，她承认AI能产生扭曲和有害的结果。但她也展示出，只要应用得当，AI也可以用于对抗不平等和歧视。“我们要打破乌托邦/反乌托邦的二元论。”她写道，“目标应该是取得进步，而非苛求完美。”

例如，在eBay上销售同一种商品时，女性卖家得到的出价往往低于男性卖家。知悉这种偏误后，该网站可以在有人出价之前隐藏卖家的个人信息，

或者提醒她们类似交易有更高的成交价。与此同时，与男性相比，女性求职者较少回应那些使用“任务关键型”和“英雄”等军事术语的招聘广告。人工智能公司Textio通过扫描列表和推荐替代措辞来帮助企业招聘女性员工。

在《平等机器》里，这样的例子俯拾皆是，揭示出一个不为人知的世界——程序员、数据科学家和活动家并不停留于抱怨AI的不足，而是致力研究实现道德目标的技术手段。这本书恰如其分地描述了各种AI系统的工作原理，但更主要的贡献是以建设性的方式重新定义待解决的问题。

隐私规则的原则之一是“最小化”：尽可能少地收集和留存信息，特别是种族、性别和性取向等信息。洛贝尔反其道而行之，表明除了招聘、薪酬和法律体系外，在数不胜数的医疗诊断和治疗案例中，知道这些特征反而可以导致更公平的结果。例如，美国监管机构过往没有根据患者性别来跟踪医疗器械的表现，但一项独立研究表明，女性遭遇伤亡的人数是男性的两倍。

洛贝尔呼吁增加而非减少使用个人信息，这挑战了正统的数据隐私观念。但她坚持认为，“追踪差异是发现不平等的关键”。她主张谨慎地放松知识产权规则，在算法决策上提供更大的透明度。她还建议采取某种针对AI的积极区别对待政策以支持弱势群体。例如，一套向男性推送高薪工作广告算法——因为过去这类职位大多被男性拿下——可以通过编程平等地向女性展示这些职位。

正如洛贝尔所说，AI未必只能复现或加深旧有的偏见。它也可以帮助揭露这些偏见。而且修正算法比改变人的思维要容易得多。

伦敦政治经济学院的埃里卡·汤普森（Erica Thompson）在《逃离模型世界》（Escape from Model Land）一书中深入探究了算法公式的种种问题。这些统计学模型是大数据和AI的支柱：如果数据是投入品，那么算法就是工具，模型就是产品。从电商经营建议到经济和气候变化预测，模型无处不在。

然而，正如作家豪尔赫·路易斯·博尔赫斯（Jorge Luis Borges）对一个帝国的等比例地图的描述一样，这个大千世界的完美模型永远也不可企及。我们只能以凡人之力确保抽象的模型尽可能地符合现实。“所有模型都是错的，”一句名言如是说，“不过有些会有用处。”

| 模型模范生

汤普森聚焦于一个她称之为“天蛾效应”的难题。在更广为人知的“蝴蝶效应”里，一个可用的模型会随着时间的推移而变得越来越不可靠，因为它所模拟的对象过于复杂，或者由于原始数据不准确。例如，在模拟气候变化时，这可能会导致对气温上升的预测产生零点几度的偏离。相比之下，“天蛾效应”是指模型本身就存在缺陷；它可能没有充分考虑湿度、风和温度之间的相互作用。这种错误的误导性要强得多，纠正的难度也大得多。

作者呼吁数据专家改进他们对现实问题的解决方案，而不仅仅是改进他们的公式——换言之，就是要逃离模型世界。“我们不需要尽量完美的答案，”她写道，“合理就行。”她还指出，在建立统计学模型之前，首先要有一个心理模型。数据科学家除了掌握数学技能外，还要有自我意识和同理心。

这两本书都以理智的现实主义态度讨论了数据、算法及其局限性。两本书都认同，要取得进步，就必须承认法律或编程方面的约束。洛贝尔倡议AI从业者纠正这一技术的各种问题；汤普森呼吁数据科学家留意模型设计中的种种选择和价值观。她们的思索为建设性的讨论奠定了基础。正如洛贝尔所言：“与其诅咒黑暗，不如点亮蜡烛。”■



The World Ahead 2023

A reality check for the metaverse is coming

Is it really the next big thing? Watch this virtual space

AFTER DESKTOP computing, the consumer internet and the smartphone boom, the consumer-computing industry is past due its Next Big Thing. The coming year will see big tech firms doubling down on two related, much-hyped possibilities. One is virtual- (VR) and augmented-reality (AR) headsets; the idea that, having shrunk computers into our pockets, the next step is to strap them to our faces. The other is the metaverse, which holds that an internet which is still largely flat—based on two-dimensional text, images and video—is ripe for replacement with one that is three-dimensional and immersive, experienced as a sort of globe-spanning video game.

Consider first the headsets, which are a small but growing market. IDC, a firm of analysts, reckons around 11m were sold in 2021, with Meta, the parent company of Facebook and Instagram, accounting for around two-thirds of sales. The firm is expected to release several new products in the coming months. On October 11th it launched its latest headset, the Meta Quest Pro. At \$1,499 it is far pricier than any of the firm's existing offerings, but cheaper, more mainstream devices are likely to follow in 2023.

The Meta Quest Pro is capable of AR as well as VR. Whereas VR acts like a digital blindfold, immersing users in a computer-generated world, AR involves painting useful information onto a user's view of the real world—something that is much harder, which may explain the higher price. Meta will have fresh competition, too. Apple, the world's biggest smartphone-maker, is likely to release its first attempt at an AR/VR headset in 2023 (one guess puts the probable price at \$3,000). Sony, whose PlayStation VR gaming headset, launched in 2016 and has sold over 5m

units, will also release an upgraded model.

Meta's ambition is not just to produce VR hardware but also to build the sort of virtual worlds that, it hopes, VR users will want to inhabit. The firm's new name is a reflection of its focus on the idea of the metaverse, a shift announced by Mark Zuckerberg, its boss, in 2021. It has since spent more than \$27bn on the idea and has trailed pictures of users, or their computer-generated avatars, working and playing in friendly, cartoonish 3D environments that range from boxing rings to virtual meeting-rooms. But many analysts are sceptical, particularly as Meta's share price has slumped.

Rival firms have similar ambitions, however. Rival tech giants, such as Microsoft and Nvidia, have trumpeted their own metaverse ambitions. Industries from advertising to banking have jumped aboard, too. But the industry that is furthest along is the video-games business, which has been selling virtual worlds for decades. Epic Games has already held live-music gigs and tie-ins with films inside "Fortnite", its popular online shooter game. Some have attracted tens of thousands of virtual revellers. Unity, which, like Epic, makes a video-game "engine" that software developers can use to power their games, has experimented with concerts of its own, and is experimenting with the 3D broadcasting of sports events.

For now, a spirit of co-operation reigns. Microsoft announced in October 2022 that it would make its Windows operating system, as well as its business-focused apps, and games written for its Xbox games consoles, available within Meta's virtual worlds. And almost every big firm in Silicon Valley has joined the Metaverse Standards Forum (MSF), which commits them to open, interoperable technical standards, so that an avatar designed for use in one company's virtual world should work without trouble in another's. (A notable exception is Apple, which has long prioritised keeping users within its own "walled garden" over compatibility with other firms' products.) In 2023 the MSF's progress, or lack of it, will be one way to gauge

whether the metaverse is an idea that has legs. It remains to be seen whether the collaborative spirit of the MSF will survive if metaverse-based services start to make serious amounts of money.

No one is quite sure whether VR, AR or the metaverse is really the future of computing. Sceptics point out that such ideas are not new. Consumer VR headsets date back to the 1990s. Smartphones already have AR apps that rely on a screen rather than a headset, such as automatic text-translation programs.

But overnight revolutions are not how technology works. Apple did not invent the smartphone out of thin air. It perfected a formula that its competitors had been working on for years, in the form of BlackBerry phones and Palm handhelds, for instance. That does not guarantee that the companies piling into these trendy technologies will succeed. But it shows why they are trying.

Tim Cross: Technology and society editor, The Economist ■



世界展望2023

元宇宙将要面对现实

它真的是“下一个大事件”吗？请关注这个虚拟空间

在台式计算机、消费互联网和智能手机的热潮之后，消费计算行业的“下一个大事物”迟迟不现身。明年，大型科技公司将在两个被大肆吹捧而又彼此相关的可能性上加倍下注。一是虚拟现实（VR）和增强现实（AR）头显。其想法是，在把电脑缩小到塞进我们的口袋后，下一步就是把它们绑在我们脸上。另一个是元宇宙，其拥趸认为，在很大程度上仍然是平面的互联网（基于二维文本、图像和视频）到了升级为三维沉浸式版本的时候了，其体验就好似某个把整颗地球纳入其中的电子游戏。

首先来看头显，这是一个很小但有增长的市场。分析师公司IDC估计2021年的销量约为1100万台，其中Facebook和Instagram的母公司Meta约占销售额的三分之二。预计该公司将在未来几个月发布几款新产品。10月11日，它推出了最新的头显型号Meta Quest Pro。其价格为1499美元，远高于该公司的任何老款产品。但是，更便宜、更大众化的设备很可能也会在2023年问世。

Meta Quest Pro兼具AR和VR功能。VR就像一个数字眼罩，让用户沉浸在计算机生成的世界中，而AR将有用的信息叠加到用户的现实视野上——这要麻烦得多，可能解释了它更高的价格。Meta也将面临新的竞争。全球最大的智能手机制造商苹果公司可能会在2023年发布其首款AR/VR头显（一种猜测估计价格为3000美元）。索尼的PlayStation VR游戏头显于2016年推出并已售出超过500万台，也将发布升级型号。

Meta的野心不仅在于生产VR硬件，还在于构建能吸引VR用户居住其中的那种虚拟世界。该公司的新名字反映了它聚焦于元宇宙理念，这是老板马克·扎克伯格于2021年宣布的一项转变。此后，该公司已在这一理念上花费了超过270亿美元，并追踪了用户图片（也就是计算机生成的化身）在从拳击台到虚拟会议室的友好而卡通化的3D环境中工作和玩耍。但许多分

析师持怀疑态度，尤其是在Meta股价暴跌的情况下。

然而，对手公司也有类似的野心。与之竞争的科技巨头，如微软和英伟达，也已大力宣传它们自己的元宇宙野心。从广告到银行，许多行业也纷纷加入。但走得最远的是视频游戏业，它销售虚拟世界已经几十年了。Epic Games已经在其流行的在线射击游戏“堡垒之夜”中举办了现场音乐演出和电影周边活动。有些活动吸引了数以万计的虚拟狂欢者。与Epic一样，Unity也生产软件开发人员可以用来自行开发游戏的视频游戏“引擎”。该公司已经试验过自己的音乐会，并且正在尝试3D广播体育赛事。

目前，合作精神占据主导。微软于2022年10月宣布它将在Meta的虚拟世界中提供其Windows操作系统、针对企业的应用，以及为其Xbox游戏机编写的游戏。几乎硅谷的每一家大公司都加入了Metaverse标准论坛

（MSF），该论坛致力于贯彻开放的、可互操作的技术标准，以便一家公司的虚拟世界中的化身在另一家公司的虚拟世界中也能畅通无阻。（一个明显的例外是苹果，它长期以来一直优先考虑将用户留在自己的“围墙花园”内，而不是与其他公司的产品兼容。）到2023年，MSF的进展——或缺乏进展——将是衡量元宇宙这个构想是否有机会成功的一个角度。如果基于元宇宙的服务开始赚大钱，MSF的协作精神是否会继续存在还有待观察。

没有人能很确定地说VR、AR或元宇宙真的就是计算的未来。怀疑论者指出这类事物并不新鲜。消费类VR头显可以追溯到1990年代。智能手机已经有了依赖屏幕而非头显的AR应用，例如自动文本翻译程序。

但技术往往并不是一夜之间天翻地覆的。苹果并非凭空发明了智能手机。它完善了竞争对手研究了多年的配方，如黑莓手机和Palm的掌上电脑等形式。这一点并不能保证纷纷投身于这些趋势性技术的公司一定会成功。但这透露了它们为什么要尝试。

蒂姆·克劳斯：《经济学人》科技与社会编辑 ■



The World Ahead 2023

Prepare for rising tensions between fiscal and monetary policy

Central bankers will remain hawkish in 2023

THE WORLD economy is slowing and many countries risk falling into recession in 2023. In America sharply higher interest rates, the necessary result of the Federal Reserve's fight with inflation, threaten to crash the housing market and raise unemployment. Tight money has brought about a strong dollar, which is exporting inflation to emerging markets and making their hard-currency debts harder to service. Europe is grappling with a severe energy crisis that is shutting factories and hurting consumers; the severity of its downturn depends significantly on the weather. And China is fighting with a housing-market crash and the instability brought about by its zero-covid policy, which entails sharp lockdowns at a moment's notice.

The first half of 2023 may bring some relief. Europe has enough gas in storage to make it through a mild winter without a major crisis. Commodity prices will stay high and volatile, but merely not repeating their rapid ascent of 2022 will be enough to cause headline annual inflation to fall somewhat. The immediate pressure will come off the Fed.

Neither the inflation problem nor the energy crisis will be over, however. The Fed faces a rate of underlying inflation that is probably around 4%, in part because labour markets are so tight, with nearly two vacancies for every unemployed worker. Europe will once again need to refill its gas storage in preparation for winter, but with much less supply from Russia than flowed in 2022. If China rebounds, global growth will be higher, but that will also increase global demand for liquefied natural gas (LNG), the supply of which is unlikely to rise materially until the middle of the decade. Higher LNG prices could make the second winter of the energy crisis harder to bear than the first.

Across the rich world, central bankers will continue to be as hawkish as it takes to contain inflation. Gone is talk of promoting employment; restoring price stability is the priority. But whereas technocrats might tolerate economic slowdowns in the name of slaying inflation, for politicians the trade-off will seem more finely balanced as worries about the economic outlook mount. In Europe, governments are spending huge sums to protect their economies from high energy costs. Britain's brief attempt to borrow more to encourage growth, now abandoned, could be repeated elsewhere. But as its ill-fated experiment showed, stimulating economies, even as central banks curtail demand by raising interest rates, is likely to backfire.

The next conflict between monetary tightening and fiscal sustainability could take place in indebted Italy. The European Central Bank (ECB) is buying Italian bonds even as it raises interest rates to fight inflation. Nonetheless, ten-year Italian debt trades at a yield 2.2 percentage points higher than the German equivalent. Even if the spread falls, in the event that the ECB has to raise rates by as much as the Fed to contain inflation, Italy's budget will come under severe stress.

Remarkably, it is also possible that monetary-fiscal conflict could strike Japan. Its enormous public net debts, of around 170% of GDP, have hitherto been sustainable because of the Bank of Japan's ongoing commitment to low interest rates amid below-target inflation. But now even Japanese inflation is rising, and the chasm between its loose monetary policy and Fed tightening is putting severe downward pressure on the yen. A turn towards monetary tightening is possible if inflation proves persistent.

The only big economy that lacks any tension between fiscal and monetary policies is China, which is not suffering from high inflation. But that is because its growth has slowed, which is no good thing. As China keeps its borders tightly controlled, loses investment to other East Asian countries with lower lockdown risk and increases government control over

businesses, the disconnect between its economy and that of the rest of the world could grow. The balancing act China faces is not between growth and unemployment, or higher rates and sustainable debts, but between the present and the future. It must fix its housing crisis without creating moral hazard that stores up problems, and find a way out of its zero-covid policy, even at the short-term cost of an “exit wave” of infections.

Elsewhere in emerging markets the challenge is coping with a tightening Fed. Middle-income countries are on the whole more robust than during past episodes of rising rates. The biggest problems are found where economic policy has perennially offended, as in Argentina and Turkey. But in poorer parts of the world, especially in Africa, many countries continue to teeter on the edge of crisis, required to negotiate debt relief with China before a bail-out from the IMF is feasible. Reconciling rising interest rates with high public debts is even harder when it is someone else’s policy decisions that matter most.

Henry Curr: Economics editor, The Economist ■



世界展望2023

准备迎接财政和货币政策之间的矛盾加剧

央行行长将在2023年保持强硬立场

世界经济正在放缓，许多国家可能在2023年陷入衰退。在美国，迅猛上升的利率是美联储与通货膨胀作斗争的必然结果，而它有可能导致房地产市场崩溃和失业率上升。货币紧缩导致美元走强，这正将通胀输出到新兴市场，并使其硬通货债务更难偿还。欧洲正在努力应对严重的能源危机，这场危机正在导致工厂关闭并伤害消费者；其衰退的严重程度在很大程度上取决于天气。而中国正在与房地产市场崩溃和清零防疫政策带来的不稳定作斗争，这一政策会在很短的时间突然内采取严厉的封锁措施。

2023年上半年可能会带来一些缓解。欧洲有足够的天然气储存度过一个温和的冬天而不会发生重大危机。大宗商品价格将保持高位波动，但只要不再重复2022年的快速上涨，就足以导致总体年度通胀率有所下降。美联储的直接压力将会减轻。

然而，通胀问题和能源危机都不会结束。美联储面临的基本通胀率可能在4%左右，部分原因是劳动力市场非常紧张，每个失业工人都对应近两个职位空缺。欧洲将再次需要补充其储气库为冬季做准备，但俄罗斯的供应量远低于2022年。如果中国经济反弹，全球增长将更高，但这也会增加全球对液化天然气的需求，而其供应量在本世纪中期之前不太可能大幅增加。液化天然气价格上涨可能使能源危机的第二个冬天比第一个更难熬。

在整个富裕世界，央行行长们将继续保持强硬态度以遏制通胀。他们再不谈促进就业了；恢复价格稳定是当务之急。但是，尽管技术官僚可能会以抑制通胀的名义容忍经济放缓，但对于政治家来说，随着对经济前景的担忧加剧，似乎要进行更加微妙的权衡。在欧洲，政府正在花费巨资来保护其经济免受高能源成本的影响。英国曾短暂地借入更多资金以鼓励增长，但这一已被放弃的尝试可能会在其他地方重演。但正如这场命运多舛的实验所表明的那样，在央行通过提高利率来抑制需求的同时，刺激经济可能

适得其反。

货币紧缩与财政可持续性之间的下一次冲突可能发生在负债累累的意大利。欧洲央行（ECB）在提高利率以对抗通胀的同时，仍在购买意大利债券。尽管如此，意大利10年期国债的交易收益率比德国国债高2.2个百分点。即使利差下降，如果欧洲央行不得不像美联储一样加息以遏制通胀，意大利的预算也将承受巨大压力。

值得注意的是，日本也可能遭受货币和财政政策冲突的冲击。由于日本央行在通胀低于目标的情况下持续承诺维持低利率，其庞大的公共净债务（约占GDP的170%）迄今为止一直是可持续的。但现在连日本的通胀率都在上升，其宽松的货币政策和美联储的紧缩政策之间的差异给日元带来了严重的下行压力。如果通胀持续，其货币政策有可能转向紧缩。

唯一在财政和货币政策之间没有任何紧张关系的大经济体是中国，它没有遭受高通胀的困扰。但那是因为它的增长放缓了，这可不是什么好事。随着中国严格控制边境，投资转向封锁风险较低的其他东亚国家，以及政府加强对企业的控制，中国经济与世界其他地区经济之间的脱节可能会加剧。中国面临的取舍不是增长还是失业，也不是高利率还是可持续的债务，而是现在还是未来。它必须解决房地产危机，同时不造成道德风险而令问题日益严重，此外要找到退出清零政策的方法，即使要付出大量感染“最后一波”的短期代价。

在其他新兴市场，挑战在于应对美联储的紧缩政策。中等收入国家如今总体上比过去利率上升期间更加强韧。最大的问题出现在经济政策长期出问题的地方，例如阿根廷和土耳其。但在世界上较贫穷的地区，尤其是非洲，许多国家继续在危机边缘摇摇欲坠，需要先与中国就债务减免进行谈判之后才能从国际货币基金组织获得纾困。当其他人的政策决定最为重要时，协调攀升的利率和沉重的公共债务就更难了。

亨利·科尔：《经济学人》经济学编辑 ■



The World Ahead 2023

Hydrogen hype is rising again—will this time be different?

Investors have been excited, and disappointed, before

GUZZLERS OF FIZZY drinks in Brisbane could be helping to tackle climate change in 2023. By the end of the year, the vehicle delivering those sugary beverages may no longer spout climate-warming gases. PepsiCo Australia, the local arm of the world's biggest purveyor of snacks and drinks, will test a new sort of lorry powered not by a dirty diesel engine but by fuel cells, devices that convert hydrogen to electricity while emitting only water vapour.

Enthusiasts are bubbling with excitement as a swirl of geopolitical and energy trends has put the spotlight once again on hydrogen, a clean fuel that can be made from a variety of primary energy sources. Hydrogen has seen previous false dawns. Two decades ago European and Japanese carmakers wasted billions chasing the dream of fuel-cell passenger cars. But governments and investors are betting that this time will be different.

One reason is growing interest in using hydrogen to replace fossil fuels in heavy industries, such as steel-making. That would help reduce carbon emissions—and could also boost energy security by reducing dependency on natural gas, the price of which has soared in the wake of Russia's invasion of Ukraine. Environmentalists love that "green" hydrogen can be made with renewable energy in electrolyzers—devices that use electricity to split water into oxygen and hydrogen. This has sparked a global rush to manufacture them, with around 600 proposed projects, about half of them in Europe. But Big Oil is keen on hydrogen too, because "blue" hydrogen can be made in a cleanish way from natural gas, if methane leaks are minimised and resulting carbon emissions are captured and sequestered.

Just how durable this latest wave of enthusiasm for hydrogen will prove to be should become clear in 2023. A global recession could slash funding for novel technologies as companies cut capital expenditure and investors grow risk-averse. Supply-chain disruptions could also spoil things. They have already forced ITM Power, a pioneering British firm, to roll back plans to scale up its production of electrolysers. And as countries respond to the energy shock they may prioritise security of supply, from dirty sources such as coal, over new technologies that can help tackle climate change.

One telltale sign will be how many of those electrolyser projects actually go ahead. Andy Marsh, chief executive of America's Plug Power, a pace-setter in the industry, predicts that global electrolyser sales will shoot up from almost zero a few years ago to \$15bn in 2023. Bernd Heid of McKinsey, a consultancy, believes the first gigawatt-scale green-hydrogen project will get the go-ahead next year. BloombergNEF (BNEF), a research firm, reckons electrolyser shipments will rise from 1GW now to 2.4-3.8GW in 2023, mostly in Asia.

But there is much enthusiasm about green hydrogen in Europe too. "Europe has been pregnant with a lot of projects but will finally give birth in 2023," says Daryl Wilson of the Hydrogen Council, an industry body. He expects the regulatory uncertainty that has held back many of those projects to be cleared up. Mr Heid predicts that Europe will conduct the first global auction for hydrogen supply and demand, and that the European Commission will set up a European Hydrogen Bank in 2023.

Perhaps, but as that BNEF forecast suggests, Asia will be worth watching, too. China is currently the biggest manufacturer of electrolysers, and the firm predicts that scaling up production will help it cut costs by 30% by 2025. India has unveiled policies to promote its own green-hydrogen industry. That is prompting Western firms to try to manufacture electrolysers and make hydrogen there. India's Greenko, a renewables firm,

thinks its joint venture with Belgium's John Cockerill, an electrolyser giant, will produce the world's lowest-cost ammonia (a fuel derived from hydrogen) by the end of 2023. homiHydrogen, an Indian startup, plans to make electrolysers that are "98% Indian-made" by that time.

But the biggest force pushing hydrogen forward in 2023 will be a tidal wave of government money in America. The Inflation Reduction Act, which is really a climate-change law, offers a staggering \$3/kg in subsidy for green-hydrogen projects. Unlike Europe's thicket of rules, America's hydrogen policy is clear and extremely compelling, experts say. Many green-hydrogen projects, currently unable to compete against dirtier forms of hydrogen (which typically cost around \$2/kg), will suddenly enjoy costs below \$1/kg. In sun-kissed or wind-swept areas, some may even see negative costs.

Mr Heid predicts that America will leapfrog Europe in attracting hydrogen projects, with total investments possibly reaching \$100bn by 2030. The global hydrogen race is hotting up, and 2023 looks to be a make-or-break year. Watch this gas.

Vijay Vaitheeswaran: Global energy and climate innovation editor, The Economist, New York ■



世界展望2023

氢能热再升温——这次会不同吗？

投资者兴奋过，也失望过

2023年，布里斯班的汽水爱好者可能会帮助应对气候变化。到明年年底，运送这些含糖饮料的车辆可能不会再喷出导致气候变暖的尾气。全球最大的零食饮料公司百事的澳大利亚分公司将测试一种新型货车，驱动它们的不是肮脏的柴油发动机，而是燃料电池，这种装置把氢转化为电而只排放水蒸气。

地缘政治演变和能源趋势汇聚而成的漩涡再次把氢放在了聚光灯下，令其拥趸兴奋不已。氢是一种可以由多种一次能源制成的清洁燃料。它曾有过虚幻的黎明。二十年前，欧洲和日本的汽车制造商浪费了几十亿计美元追逐燃料电池乘用车的梦想。但政府和投资者都认为这一次会不一样。

原因之一是人们日益有兴趣在炼钢等重工业中用氢替代化石燃料。这将有助于减少碳排放，还可以通过减少对天然气的依赖来促进能源安全——天然气的价格在俄罗斯入侵乌克兰后飙升。环保主义者青睐用可再生能源在电解槽中制造“绿”氢的点子，电解槽是用电力把水分解成氧气和氢气的设备。这引发了全球制造它们的热潮，已提出了大约600个项目，其中约一半在欧洲。但石油巨头对氢也很热衷，因为如果把甲烷泄漏降至最低并捕获和封存所产生的碳排放，就可以用尚算清洁的方式由天然气制得“蓝”氢。

这波最新的氢能热会多持久，在2023年应该会有答案。一轮全球经济衰退可能会大幅减少新技术的融资，因为企业削减资本支出，投资者规避风险。供应链混乱也可能误事。它们已经迫使英国的先驱公司ITM Power取消了扩大电解槽生产的计划。随着各国应对能源冲击，它们可能会优先考虑来自煤炭等肮脏能源的供应稳定性，而不是有助于应对气候变化的新技术。

一个能说明问题的迹象将是这些电解槽项目中有多少会被实际推进。行业领头羊、美国的普拉格能源（Plug Power）的首席执行官安迪·马什（Andy Marsh）预测，全球电解槽销售额将从几年前的几乎为零猛增至2023年的150亿美元。咨询公司麦肯锡的伯恩德·海德（Bernd Heid）认为，第一个吉瓦级绿氢项目将于明年获批。研究公司彭博新能源财经（BNEF）估计电解槽出货量将从现在的1吉瓦增加到2023年的2.4-3.8吉瓦，主要在亚洲。

但欧洲也对绿氢充满热情。“有许多项目在欧洲酝酿，但最终会在2023年成形。”行业机构氢能委员会（Hydrogen Council）的达里尔·威尔逊（Daryl Wilson）说。他预计阻碍许多此类项目的监管不确定性将消除。海德预测，欧洲将举行首次全球氢供需拍卖，欧盟委员会将在2023年设立欧洲氢银行。

也许会吧，但正如彭博新能源财经的预测所提示的，亚洲也将值得关注。中国目前是全球最大的电解槽生产国，该预测称扩大生产规模将有助于中国在2025年前将生产成本降低30%。印度已经出台了促进本国绿氢产业的政策。这促使西方公司尝试在那里生产电解槽和制氢。印度的可再生能源公司Greenko认为，其与比利时电解槽巨头John Cockerill的合资企业将在2023年底之前生产出世界上成本最低的氨（一种用氢制取的燃料）。印度创业公司homiHydrogen计划到那时制造出“98%印度制造”电解槽。

但在2023年推动氢能发展的最大力量将是美国政府的一波资助潮。《通胀削减法案》（Inflation Reduction Act）实则是一部气候变化法案，它为绿氢项目提供每公斤3美元的惊人补贴。专家表示，与欧洲繁杂的规则不同，美国的氢能政策清晰明确且极具吸引力。许多绿氢项目目前无法与更脏形式的氢（通常成本约为每公斤2美元）竞争，但将突然开始享受每公斤不到1美元的成本了。在阳光普照或疾风劲吹的地区，成本甚至可能为负。

海德预测，美国在吸引氢能项目方面将超越欧洲，到2030年总投资可能达到1000亿美元。全球氢能竞赛正在升温，2023年看起来是成败攸关的一

年。关注这种气体。

范思杰：《经济学人》全球能源和气候创新编辑，纽约■



The World Ahead 2023

How the war in Ukraine could influence technological innovation

Increased defence spending means more money for research

IF YOU HAVE watched any videos from the front lines in Ukraine, you have unwittingly used a military technology. The internet, like lasers, GPS and mRNA vaccines, is an invention that came about thanks to military investment—specifically, from DARPA, an agency of the Pentagon that tries to advance cutting-edge technology.

In the wake of Russia's invasion, new technologies could be on their way, because the war has prompted countries to boost defence spending. For politicians, says Stefanie Tompkins, the head of DARPA, Ukraine has “taken things from abstract to reality”. America has already increased its defence spending by 5%; Germany has promised to increase its own budget by a third. Much of the new cash will go on recapitalising the depleted stocks of weapons and ammunition given to Ukraine. But some will trickle down to research and development budgets, potentially producing revolutionary new technologies.

Projects currently under way offer a glimpse of the future. One area of focus, says Dr Tompkins, is improving supply chains. Rather than having to transport food, medicine, water and fuel to soldiers in remote locations, raising concerns about cold storage and logistics, DARPA hopes to be able to manufacture them all on-site—from protein and petrol to painkillers—using novel biotechnology.

This and other military-focused innovations could reshape civilian life. Many countries are trying to develop hypersonic weapons, which travel at 5-25 times the speed of sound. Venus Aerospace, an American startup, hopes to use the same technology to build a space plane that could fly

passengers anywhere on Earth within an hour.

Similarly, America, Australia, Britain and the EU are all eagerly pursuing quantum computers, which could solve problems that are too hard for conventional ones. Much research to date has been funded by defence and intelligence services, says William Oliver, director of the quantum-engineering centre at MIT. Yet no one is sure how useful quantum computers might be in practice—or how to tell when they're working. Hence DARPA's "quantum benchmarking" programme, which Dr Tompkins describes as providing a framework to determine "whether quantum computing is actually going to be useful".

Analysts note that military R&D is not nearly as important as it was in DARPA's heyday, at the height of the cold war. An enormous technology industry and large amounts of venture capital mean defence money is more fungible. But for "truly novel" technologies, says Amy Kruse, an investor and former DARPA officer, military budgets remain critical. Vladimir Putin's war may have unexpected technological spin-offs.

Shakeel Hashim: Freelance correspondent ■



世界展望2023

乌克兰的战争如何影响科技创新

国防支出增加了，研究资金也会更多

如果你看过任何来自乌克兰前线的视频，那你已经在不知不觉间使用了一项军事技术。互联网这个发明的产生就和激光、GPS和mRNA疫苗一样，得益于军方投资——具体来说，投资来自于五角大楼属下力图推进尖端技术的国防部高级研究计划局（DARPA）。

俄罗斯入侵之后，各种新技术可能将出现，因为这场战争已经促使各国增加国防开支。DARPA的负责人斯蒂芬妮·汤普金斯（Stefanie Tompkins）说，在政客们看来，乌克兰已经“将抽象的东西变成了现实”。美国已经将国防开支增加了5%；德国承诺将国防预算增加三分之一。大部分新资金将用于补充向乌供武后耗尽的武器弹药库存。但有些资金会下渗到研发预算，有可能会催生革命性的新技术。

目前正在进行的项目让人一瞥未来的趋势。汤普金斯说，一个重点领域是改善供应链。DARPA希望能够利用新的生物技术，在前线就地制造从蛋白质到汽油再到止痛药的所有物资，而不必向偏远地区的士兵运送食品、药品、水和燃料，免除对冷藏和物流的担忧。

这种以及其他军事目的的创新可能会重塑平民的生活。许多国家都在尝试开发飞行速度达音速5到25倍的高超音速武器。美国创业公司Venus Aerospace希望利用同样的技术打造一架空天飞机，可以在一小时内将乘客送到地球上的任何地方。

同样地，美国、澳大利亚、英国和欧盟都在积极钻研量子计算机，它可以破解传统计算机难以解开的问题。麻省理工学院量子工程中心负责人威廉·奥利弗（William Oliver）说，迄今为止，许多这方面的研究都是由国防和情报机构资助的。然而，没有人能确定量子计算机在实践中有多大用处，或者如何判断它们什么时候发挥了作用。于是就有了DARPA的“量子

基准”项目，按汤普金斯的描述，它提供了一个框架来确定“量子计算是不是真的会有用”。

分析人士指出，军事研发已经不像在冷战高峰期DARPA如日中天的时候那么重要了。有了庞大的科技产业和大量风险资本，国防资金也就没那么无可取代。但投资人兼前DARPA官员艾米·科鲁斯（Amy Kruse）说，对于“真正新颖”的技术，军事预算仍然至关重要。普京发起的战争可能会带来意想不到的技术副产品。

沙基尔·哈希姆（Shakeel Hashim）：自由撰稿人 ■



The World Ahead 2023

Take that, covid! “Revenge” tourism takes off

As restrictions ease, travellers show the coronavirus who’s boss

ECONOMISTS CALL it “pent-up demand”. But people who were stuck at home during the pandemic have another name for the rebound in travel that will continue in 2023: “revenge” tourism, as travellers show the virus who’s boss. International tourism arrivals, up 60% in 2022, will rise by a further 30% in 2023, to 1.6bn, still short of 2019’s figure of 1.8bn. But tourist receipts in 2023 will almost equal the 2019 total of \$1.4trn, if only because inflation has pushed up prices. War in Ukraine has hampered the recovery, as has China’s zero-covid policy: one in ten tourists was Chinese before the pandemic. Their numbers will double in 2023, to 59m, far below the 155m recorded in 2019. As beaches and sun-loungers fill up again, this is a case where revenge is best served hot. ■



世界展望2023

瞧好吧，新冠！“报复性”旅游来袭

随着防疫限制措施放松，旅行者告诉新冠病毒谁才是老大

经济学家称之为“被压抑的需求”。但是，在新冠疫情期间被困家中的人们对2023年仍将持续的旅行反弹有另一个叫法：“报复性”旅游，因为旅行者要向病毒宣示谁说了算。国际旅游人数在2022年增长了60%，到2023年将进一步增长30%，达到16亿，仍低于2019年的18亿。但2023年的旅游收入将几乎等同于2019年的总额1.4万亿美元，这仅仅是因为通货膨胀推高了价格。乌克兰的战争阻碍了旅游业复苏，中国的清零抗疫政策也一样：疫情爆发前，十分之一的游客是中国人。他们的数量将在2023年翻一番，达到5900万，远低于2019年录得的1.55亿。随着海滩和躺椅再次被人群填满，这种报复最好是趁热消受。 ■



The World Ahead 2023

23 items of vital vocabulary you'll need to know in 2023

Passkeys? Post-quantum cryptography? Vertiports? Get up to speed here

IN 2020 AND 2021 the world embarked on a crash course in epidemiology and vaccinology. Novel expressions such as “flattening the curve”, “viral load”, “spike protein” and “mRNA vaccines” became part of the public discourse. Then in 2022 the war in Ukraine made it grimly necessary to learn new terms, such as “HIMARS” and “counter-battery fire”. What terms of art will enter wider circulation in 2023? Here are our best 23 guesses, with a definition of each one, to expand your vocabulary for the coming year.

| *Green, blue and brown hydrogen*

Hydrogen is a colourless gas that burns cleanly, producing just water vapour. Despite being the most abundant element in the universe, it is rarely found on Earth in a pure form. When making pure hydrogen, some methods are much dirtier than others—so energy wonks use different colours to identify them. “Green” hydrogen is made using renewable energy to split water into hydrogen and oxygen via electrolysis. Europe is promoting its use, and renewables-rich regions from Australia to India hope to become green-hydrogen exporters. By contrast, making “black” or “brown” hydrogen involves burning coal or lignite, releasing huge amounts of carbon dioxide. This is cheap but bad for the climate. “Grey” hydrogen is made from natural gas, in a process that also releases carbon dioxide (but less than using coal). “Blue” hydrogen is also made from natural gas, but the resulting carbon dioxide is then captured and stored underground. Big Oil is excited about this, because in theory it can also be relatively green, if leaks are tightly monitored and controlled. “Turquoise” hydrogen uses a different process to split natural gas, resulting in hydrogen and solid

carbon. Several startups are pursuing this approach. “Pink” hydrogen is, like the green sort, made using electrolysis, but powered by nuclear energy. Finally, “white” hydrogen is the pure kind that occurs in nature but is rare on Earth.

| *eSIM*

Those tiny chips that go into your smartphone and link it to your billing details and phone number—known as subscriber identity modules, or SIMs—are going away. So-called eSIM technology replaces physical chips with digital codes that can be zapped from an old handset to a new one. The technology has been in phones since 2017, but Apple’s decision to launch its iPhone 14 range in America as eSIM-only handsets will force millions of people to start using it in 2023. As with mice and touchscreens, Apple’s embrace of a technology will be the trigger for widespread adoption. It will push mobile operators around the world to move to eSIMs and make the process of transferring them between devices less clunky. The technology also makes it easier to roam between networks by installing multiple eSIMs—less fiddly than swapping tiny chips.

| *Post-quantum cryptography*

Quantum computers exploit the weirdness of the subatomic realm to do things that ordinary computers cannot. That includes cracking codes: a working quantum computer, if one can be built, could break the encryption that is currently used to secure communications and protect sensitive data. To protect against this possibility, new “post-quantum” cryptography standards, designed to be invulnerable even to quantum computers, were approved in 2022, and preparations for their implementation will begin in earnest in 2023.

| *Mixed reality*

Virtual reality (VR) is like wearing a digital blindfold—it blots out the real

world and immerses you in an alternative, computer-generated reality. Augmented reality (AR), by contrast, superimposes computer-generated elements onto your view of the real world. Mixed reality (XR or MR) goes a step further by allowing real and virtual items to interact. For example, you might play a game of table tennis in which the paddles are real, but the ball is computer generated. It is also a less clunky term than augmented reality, and more likely to catch on. A big question for 2023 is what Apple will choose to call the technology when it announces its first AR/VR/XR headset—which is rumoured to be powered by software called “realityOS”.

| *Passkeys*

Death to passwords! Passkeys are a new technology, supported by tech giants including Apple, Google and Microsoft, that replace passwords with biometrically validated tokens that are automatically generated and cannot be guessed or forgotten. Essentially, instead of typing a password, you use a token, stored on your phone or computer and protected by a fingerprint or facial recognition, to log into apps or websites. Many online services, including eBay, Kayak and PayPal, are using this approach already, and more will follow in 2023 as support for the technology is extended to the latest versions of popular desktop and mobile operating systems.

Because a unique passkey is generated for every app or website you use, passkeys prevent many common attacks, such as “phishing” emails that trick users into entering their credentials into a plausible-looking, but bogus, website. Passkeys also, by default, stop people from using the same (often easily guessed) password for everything. All this should give online security a big boost—with the added benefit that logging into something by clicking your smartwatch is strangely thrilling.

| *Horizontal and vertical escalation*

How might the conflict in Ukraine escalate in 2023? Military wonks distinguish between two dimensions of escalation. Horizontal escalation is

where the geographical scope of a conflict expands (for example, if Russia attacks another country, drawing it into the conflict). Vertical escalation is where the intensity of the conflict increases, either with attacks on new types of targets, or through the introduction of new types of weapon (such as chemical or nuclear warheads). Neither is good.

| *Tactical nuclear weapons*

Might Russia resort to the use of “tactical” nuclear weapons in Ukraine? These tend to have shorter ranges and lower yields than city-busting “strategic” weapons, such as ICBMs. If, say, Ukraine’s forces were about to reclaim Crimea in 2023, Vladimir Putin might be tempted to use one to halt Ukraine’s military advance. But it is unlikely to be very effective: one warhead might destroy just a dozen tanks. Mr Putin might instead opt to detonate a small nuke over the Black Sea as a warning. But allies such as China might then abandon him. And the West would surely respond, perhaps hitting Russian targets in Ukraine with conventional weapons. Tit-for-tat attacks then risk leading to an exchange of much more powerful strategic weapons. “Tactical” is, in short, a misnomer when it comes to nukes: they are inherently, perilously strategic.

| *Frozen conflict*

A frozen conflict is a military stand-off in which actual combat has ceased, but there has been no resolution of the underlying conflict (for example, through a peace treaty or political settlement)—so there is a risk that hostilities might restart at any time. They are often the result of big-power meddling. Vladimir Putin has created several frozen conflicts in parts of the former Soviet Union (including, from late 2014 until early 2022, in eastern Ukraine) as a way of destabilising neighbouring countries. Such conflicts can last decades, as with South Ossetia and Abkhazia, Russia-backed republics that broke away from Georgia in the early 1990s. In 2023, Russian weakness may mean that some of these frozen conflicts start to thaw.

| *Regasification*

Natural gas is normally delivered via pipelines, because unlike oil, it is difficult to load and unload onto ships. This makes natural-gas markets much less liquid than those for oil, because a pipeline is generally needed between buyer and seller. But liquefied natural gas (LNG) changes the equation. Cooling natural gas down to -162°C turns it into a liquid and reduces its volume 600-fold, enabling it to be transported over long distances using special, cryogenically cooled tanker ships.

This allows for global trade in natural gas—handy for European countries that wish to reduce their reliance on Russian gas delivered by pipelines. Lately, European countries have instead been buying it from America or Qatar, two big LNG exporters. Turning LNG back into a gas, so that it can be fed into pipelines and used as a fuel, is called regasification. This normally takes place at a coastal LNG terminal. But building onshore facilities takes time, so a quicker solution is to lease ships, called “floating storage and regasification units”, to do the job. Germany’s government has chartered five such ships to boost its LNG import capacity.

| *Aridification*

At what point is drought, or even megadrought, no longer sufficient to describe a dry period? In some places scientists and officials now talk instead of aridification, or the long-term drying of a region. Higher temperatures caused by climate change have plenty of knock-on effects. In already arid regions such as southern Europe, coastal Australia and southern Africa, climate change is shrinking mountain snowpack and drying out rivers, soils and forests. In California, Spain and elsewhere, summer brings the threat of ever-more severe wildfires. In 2023, these regions will grapple with hotter temperatures, more intense wildfires and less water. Aridification will force agricultural powerhouses, such as California and China, to reckon with shrinking water supplies. And parched

cities will worry that it could put a ceiling on population growth.

| *Scope 1, 2 and 3 emissions*

Scope 1 emissions are those directly caused by a company's activities, such as burning fuel in factories or vehicles. Scope 2 emissions are indirect emissions (from a power station, for example) that result from a firm's energy use. Scope 3 emissions are all other emissions that arise from the activities of a company's suppliers and customers. For an oil company, the emissions that result when the oil it sells is burned by others are Scope 3 emissions. Should firms be liable for such emissions? In 2023, expect more regulators to argue that they should.

| *Resilience hubs and cool pavements*

Cities around the world are adopting various measures to deal with the threat of heatwaves, which are increasing in frequency and severity, and put old and infirm people at particular risk. Resilience hubs are designated buildings—or, in some cases, pods made from shipping containers—within a community that provide air-conditioned places of refuge with drinking water, internet access and phone-charging facilities. Cities are also reducing temperatures by introducing cool roofs (covered with white paint or reflective materials) and cool pavements (treated with special coatings) to reflect sunlight away and absorb less heat. Cities pioneering cool sidewalks and road surfaces include Los Angeles, Phoenix and Tokyo.

| *Dead pool*

Most people will associate “dead pool” with Marvel's sarcastic anti-hero, played by Ryan Reynolds on the silver screen. In America's western states, however, it has a different meaning. Most of the West's big reservoirs were created by damming rivers in the 20th century. But these man-made lakes have shrunk over the past two decades as the rivers that feed them have dried up. When a reservoir is depleted to the point where water can no

longer be sent downstream, it becomes a static, or dead, pool. In 2023 some reservoirs will move closer to this state. Lake Mead and Lake Powell—America’s two largest reservoirs, which straddle the Colorado river—have become dangerously dry. Should Lake Powell hit dead pool, water supplies would dwindle for the 40m people across the south-west who depend on the Colorado River for water.

| *Synfuels and e-fuels*

Synthetic fuels, also known as synfuels, are drop-in replacements for conventional hydrocarbon fuels (such as petrol, diesel and jet fuel), that are produced artificially rather than being made from oil. Electrofuels or e-fuels are synfuels made using renewable energy. Solar or wind power is used to split water into hydrogen and oxygen via electrolysis. The hydrogen is then combined with carbon dioxide, either taken from industrial processes or extracted from the atmosphere, to produce a hydrocarbon fuel. Depending on the process used, the resulting fuel can have a lower carbon footprint than conventional fuel, or be entirely carbon neutral. E-fuels make little sense for road vehicles (which can be easily electrified) but could power ships and planes by, in effect, repackaging renewable electricity as a liquid fuel.

| *Productivity paranoia*

Does working from home make you more productive? In a survey by Microsoft of 20,000 workers in 11 countries, 87% thought they worked just as efficiently, or more efficiently, from home. But only 12% of bosses had full confidence that their teams were being productive. The result is “productivity paranoia”, both among workers (afraid of being seen as shirkers) and bosses (afraid that workers are shirking). It can, in turn, lead to displays of “productivity theatre” as workers strive to demonstrate they are pulling their weight.

| *TWaT city*

Fears early in the covid-19 pandemic that people would never return to offices were misplaced. But so were hopes that people's working habits would eventually return to normal. Instead many workers have fallen into a pattern of travelling to the office only on Tuesdays, Wednesdays and Thursdays. Cities are in denial about this trend, but in 2023 they will have to adapt to the "TWaTs". Bars are packed on Thursday evenings as workers say farewell to each other; watering holes can adapt fairly easily by altering shift rotas. But offices will have to be more creative, either by reducing staffing or finding other uses for their spaces on quiet days. Public-transport operators will have to adjust, too. Instead of reducing services on Mondays and Fridays, they could try shifting demand by cutting prices on those days, and increasing them between Tuesday and Thursday.

| *Doughnut effect*

The pandemic-driven rise of working from home means that people prize proximity to offices less and domestic space more. Nicholas Bloom of Stanford University and Arjun Ramani, who is now a correspondent at The Economist, have identified a "doughnut effect" in large cities. As workers move away from city centres, suburban rental values have shot up, creating a ring of growth. This name relies on the fact that American doughnuts have holes in the middle. Commercial-property developers hope that people can be lured back to city centres by exceptional amenities such as beautiful offices and fantastic views. They envisage the British kind of doughnut which, instead of having a hole in the middle, is filled with jam.

| *Battery Belt*

The Rust Belt is the name given to parts of America that have suffered from the decline of manufacturing since the 1950s. Now efforts are under way to revitalise these regions by promoting investment in new, green industries such as electric-car manufacturing and "gigafactories" that make

automotive batteries. Ford is investing \$50bn to expand production of electric vehicles, its rival GM is investing \$35bn, and an estimated \$40bn is going into new or expanded battery production in this new “Battery Belt”. Will the name catch on in 2023?

| *YIMBY*

Whereas NIMBYs want nothing built in their backyards, YIMBYs say “yes” to development. Preferring high-density development to car-driven sprawl, they have been around for years, but have had limited success in altering planning rules. That will change in 2023. In July the Affordable Housing and High Road Jobs Act comes into effect in California. It will make it easier to build homes in areas currently dominated by offices, shops and car parks and will ease the rigid separation of living and working areas created by zoning laws. California is also watering down rules that force developers to provide so much parking space. Parking obligations will be weakened for new developments close to public transport, which should reduce construction costs and prices. And where California leads, the rest of the world tends to follow eventually.

| *Virtual power plant*

A growing number of homes and businesses have solar panels and batteries that can provide electricity to the property and can also deliver power to the electricity grid when needed. When used together in large numbers, and co-ordinated via internet commands, hundreds or thousands of these small-scale generation and storage systems can act in concert, functioning, in effect, as a virtual power plant that can be switched on and off at short notice. Users must opt in to allow their equipment to be used in this way, and they are paid for the energy supplied.

Virtual power plants can eliminate the need for expensive, polluting “peaker plants” to maintain supply at peak times. They can also help electrical utilities with frequency regulation and voltage control, both of

which must be managed carefully to balance supply and demand, particularly on electrical grids that rely heavily on intermittent sources such as solar and wind power. Virtual power plants are an example of how “smart grids” can facilitate the shift towards renewable energy sources. They have been deployed in Australia, Britain, California and Germany.

| *Vertiport*

Air taxis, also known as flying cars or eVTOL (electric, vertical takeoff and landing) aircraft, are essentially multicopter drones that are large enough to carry people. Several firms around the world hope such vehicles will win regulatory approval in 2023 as a fast, sustainable form of urban transport. But eVTOLs can't take off and land just anywhere. Instead, they will need designated places to do so—so-called vertiports—that are half-airport, half-subway station, and that allow eVTOLs to be integrated with existing transport networks, such as road and rail. All of this poses a new challenge to architects and urban designers, who are already coming up with some distinctive designs. Vertiports will be needed if eVTOLs are to get off the ground.

| *Space solar power*

The idea of capturing energy in space using huge solar arrays attached to orbiting satellites, and then beaming it down to Earth as microwaves, has been around since Isaac Asimov proposed it in a science-fiction story in 1941. But the sums have never added up: launching things into space simply costs too much. That could change if launch costs fall far enough, or if new space-based manufacturing techniques emerge, such as mining asteroids for raw materials. And in a high enough orbit, a solar-power satellite could stay in sunlight around the clock, providing a clean, reliable source of power. The European Space Agency sponsored a ground-based demonstration in Germany in 2022 as part of a proposed scheme called Solaris. America, Britain, China and Japan are also funding research in the

field, which is experiencing a new dawn.

| *Cislunar*

America intends to send astronauts to the Moon in the next few years, with the long-term goal of establishing a permanent base there. As part of its Artemis programme it intends to put a space station, called the Lunar Gateway, in orbit around the Moon to act as a communications hub, science laboratory and short-term living space; it is due to launch in 2024. A series of preparatory robotic missions to the Moon will blast off in 2023. Things are hotting up in “cislunar” space—as the space between Earth and the orbit of the Moon is known.

Written by Martin Adams, Aryn Braun, Joel Budd, Tom Standage and Vijay Vaitheeswaran ■



世界展望2023

2023年你需要知道的23个重要名词

通行密钥？后量子密码学？垂直起降机场？本文为你一一介绍【深度】

在2020年和2021年，全世界上了一个流行病学和疫苗学的速成班。“拉平曲线”、“病毒载量”、“刺突蛋白”和“mRNA疫苗”等新奇名词已融入公共语汇。到了2022年，乌克兰战争爆发，这让了解“HIMARS”（海马斯火箭炮）和“反炮兵火力”之类的新术语变得非常有必要。2023年哪些词将流行起来？我们做了番猜测，选出了最看好的23个，每个都附上了定义，以扩大您来年的词汇量。

| 绿氢、蓝氢和棕氢

氢气是一种无色气体，燃烧后只产生水蒸气，非常清洁。尽管氢是宇宙中最丰富的元素，但在地球上却很少以纯氢的形式存在。在制取纯氢时，方法不同，污染程度也不同，所以能源专家用不同的颜色来加以区别。“绿”氢是利用可再生能源将水电解成氢和氧而来的。欧洲正在推广绿氢的使用，从澳大利亚到印度的可再生能源丰富的地区都希望成为绿氢出口国。相比之下，制取“黑”氢或“棕”氢需要燃烧黑煤或褐煤，会释放大量二氧化碳，成本虽低，但对气候不利。“灰”氢从天然气中制取，过程中也会释放二氧化碳，但少于燃烧煤炭。“蓝”氢也是从天然气中制取，但随之产生的二氧化碳会被捕获并封存于地下。石油巨头对此很兴奋，因为如果能严格监控和控制二氧化碳的逃逸，理论上蓝氢也可以是相对环保的。“蓝绿”氢采用了不同的方法分解天然气，在制氢的同时还会产生固体碳。几家创业公司正在采用这种方法。与绿氢一样，“粉”氢是通过电解制取的，但能源来自核能。最后还有“白”氢，是地球上自然存在但非常少见的纯氢。

| eSIM卡

装在智能手机里绑定你手机账单信息和电话号码的微型芯片，也就是全称为“用户身份模块”的SIM卡，将逐渐消失。所谓的eSIM技术将以数字代码取代物理芯片，用户可轻松地把它从旧手机转到新手机上。该技术从2017

年开始就已经在手机中使用，但苹果在美国版iPhone 14系列中仅使用eSIM卡的决定将迫使数以百万计的用户在2023年开始使用这一虚拟卡。就像鼠标和触摸屏一样，苹果积极采用一项技术，就会促成它的普及。这将推动世界各地的移动网络运营商转向eSIM卡，并让换手机时换卡不再那么不顺畅。该技术还可以安装多个eSIM卡，让用户在不同运营商的网络之间轻松切换，这可比切换SIM卡简单多了。

| 后量子密码学

量子计算机利用亚原子王国的奇异特性来做普通计算机做不到的事情。其中就有破解密码。如果量子计算机能成为现实，它将可以破解目前用于保护通信和敏感数据的加密算法。为了防止这种情况，能让量子计算机也无隙可乘的“后量子”密码学标准在2022年获批，实施准备工作将于2023年正式开始。

| 混合现实

虚拟现实（VR）就像是给人戴上数字眼罩，遮住现实世界，让用户沉浸在计算机生成的另类现实之中。相比之下，增强现实（AR）是将计算机生成的元素叠加到用户感知到的真实场景上。混合现实（XR或MR）则更进一步，可以让真实与虚拟物体交互。例如，在一场混合现实的乒乓球赛中，球拍是真实存在的，而球是计算机生成的。混合现实的英语全称也比增强现实更顺口，更有可能流行起来。2023年的一个大问题是，苹果在发布其首款AR/VR/XR头显时会给这项技术起个什么名字。据传，该头显将由名为“realityOS”的软件驱动。

| 通行密钥

密码要消亡啦！通行密钥这项新技术得到了包括苹果、谷歌和微软在内的科技巨头的支持，它用经生物识别验证的令牌取代了密码，这些自动生成的令牌无法被猜到，也不会被遗忘。基本上就是说用户不用输入密码，而是使用存储在手机或计算机上受指纹或面部识别保护的令牌来登录应用或网站。包括eBay、Kayak和PayPal在内的许多在线服务已经在运用这种技术，随着流行的桌面和移动操作系统的最新版本开始支持该技术，2023年

将有更多服务采用通行密钥登录。

由于会为用户使用的每一个应用或网站生成一个唯一的通行密钥，它可以防止许多常见的攻击，例如会诱骗用户在一个看似真实、实则虚假的网站上输入登录凭证的“钓鱼”邮件。默认情况下，密钥还能阻止人们在所有网站和应用都使用相同（而且通常很容易猜到）的密码。这一切应该能大大提高在线活动的安全性，而且还有一个额外的好处，那就是点击智能手表就能登录会让人莫名兴奋。

| 横向升级和纵向升级

2023年乌克兰冲突会如何升级？军事专家提出了两个维度上的升级。横向升级，就是冲突的地理范围扩大（例如俄罗斯攻击另一个国家，将其拖入冲突）。纵向升级，指冲突的强度增加，要么通过攻击新目标，要么通过引入新武器（如化学武器或核弹头）。这两种升级都不是好事。

| 战术核武器

俄罗斯有可能在乌克兰使用“战术”核武器吗？与洲际弹道导弹等能夷平城市的“战略”武器相比，“战术”核武器的射程更短、当量更低。比方说，假如乌克兰军队要在2023年收复克里米亚，普京可能会忍不住想动用“战术”核武器来阻止乌军推进。但这种武器不太可能有很大效果——一枚弹头可能只能摧毁十几辆坦克。普京可能会选择在黑海上空引爆一枚小型核弹作为警告。但中国等盟友可能会因此抛弃普京，西方也肯定会做出回应，也许会用常规武器打击在乌克兰的俄罗斯目标。这样的针锋相对有可能会导致双方动用厉害得多的战略武器交战。简而言之，在核武器前面加上“战术”一词属于用词不当，因为核武器本质上就是危险的战略武器。

| 冻结冲突

冻结冲突是一种军事对峙状态，实际战斗已经停止，但根本冲突没有得到解决（例如通过和平条约或政治解决方案），因此存在战争可能随时重新开始的风险。冻结冲突通常是大国干预的结果。普京在前苏联的一些地区制造了数起冻结冲突（包括从2014年底到2022年初在乌克兰东部的冲突），以此破坏邻国稳定。此类冲突可能会持续数十年，例如在南奥塞梯

（South Ossetia）和阿布哈兹（Abkhazia）的情况，这两个由俄罗斯支持的共和国在20世纪90年代初脱离了格鲁吉亚。2023年，俄罗斯实力减弱可能意味着其中一些冻结冲突会开始解冻。

| 再气化

天然气与石油不同，很难用船只装卸，通常要通过管道输送。这让天然气市场的流动性远低于石油市场，因为买卖双方之间通常需要有管道连通。但是液化天然气（LNG）改变了这种情况。冷却至-162°C后天然气会变成液体，体积会缩小到六分之一，从而能够用配有低温冷却储罐的特制天然气船长距离运输。

这让全球天然气贸易成为可能，对希望减少依赖俄罗斯管道天然气的欧洲国家来说非常有用。最近，欧洲国家改从美国或卡塔尔这两大LNG出口国购气。要把LNG送入管道用作燃料就要把它变回气体，这个过程叫再气化，通常在沿海的LNG接收站进行。但建造陆上设施需要时间，因此更快的解决方案是租用称为“浮式储存和再气化装置”的船只来完成这项工作。德国政府已经租用了五艘这样的船来提高其LNG进口能力。

| 干旱化

在什么情况下，旱情甚至特大旱情一词都已不足以描述一段干旱时期的严重程度呢？在一些地方，科学家和官员开始使用干旱化一词来形容一个地区的长期干旱。气候变化导致的气温升高会产生很多连锁反应。在欧洲南部、澳大利亚沿海和非洲南部等本就干旱的地区，气候变化正在减少山区积雪，导致河流干涸、土壤干燥、森林干枯。在美国加州和西班牙等地，夏季的山火风险越来越高。在2023年，这些地区将面临气温更高、山火更猛，水资源更匮乏的局面。干旱化将迫使加州和中国等农业重地去努力应对水资源供应减少的问题。缺水的城市会担心干旱化将限制人口增长。

| 范围1、2、3排放

范围1排放是指公司的工厂或车辆燃烧燃料等活动直接造成的排放。范围2排放是公司使用能源产生的间接排放（例如发电站的排放）。范围3排放是公司供应商和客户的活动所产生的所有其他排放。对于一家石油公司而

言，它销售的石油被其他公司燃烧后所产生的排放属于范围3排放。企业是否应对此类排放负责？到2023年，预计会有更多监管机构认为它们应该担起责任。

| 韧性中心和清凉人行道

世界各地的城市都在采取各种措施来应对热浪威胁。热浪正变得越来越频繁，也越来越严重，对年老体弱者的威胁尤其大。韧性中心是社区内的指定建筑物，有时是用集装箱制成的舱房，提供空调、饮用水、网络和手机充电设施，供市民躲避热浪之用。城市还通过引入清凉屋顶（涂有白色油漆或覆盖了反光材料）和人行道（经过特殊涂层处理）来反射阳光，减少热量吸收，从而降低温度。率先建设清凉人行道和路面的城市有洛杉矶、凤凰城和东京。

| 死水池

看到“dead pool”这个词，大多数人会联想到漫威电影《死侍》中莱恩·雷诺兹（Ryan Reynolds）饰演的贫嘴反英雄人物。然而在美国西部的几个州，这个词有着不同的含义。美国西部的大部分大型水库都是上世纪在河上建坝形成的。但在过去二十年里，由于上游河流枯竭，这些人工水库不断缩小。当水库水位低到一定程度，无法再向下游输水时，就会变成一个死水池。到2023年，一些水库将接近这种状态。横跨科罗拉多河

（Colorado river）的米德湖（Lake Mead）和鲍威尔湖（Lake Powell）这两个美国最大的水库水位已降至危险水平。如果鲍威尔湖变成死水池，美国西南部依赖科罗拉多河供水的4000万人口将面临供水紧张。

| 合成燃料和电制燃料

合成燃料（英文也作synfuel）可直接替代传统的碳氢化合物燃料（如汽油、柴油和航空燃油），这种燃料由人工合成，而不是从石油中提取。电制燃料（e-fuel）是用可再生能源生产的合成燃料。先利用太阳能或风能发电，再将水电解为氢气和氧气，然后将氢气与从工业流程或大气中提取的二氧化碳结合，生成碳氢化合物燃料。所得燃料的碳足迹会比传统燃料小，甚至可以完全达到碳中和，这取决于具体工艺。电制燃料对公路车辆

（很容易电气化）意义不大，但可以为船舶和飞机提供动力，方法实际上就是把可再生电力重新转换为液体燃料。

| 生产率妄想症

居家工作会效率更高吗？微软对11个国家的两万名员工做了一项调查，发现87%的员工认为在家工作的效率和在公司一样，甚至更高。但只有12%的老板对自己团队的工作效率有信心。结果就产生了“生产率妄想症”，员工有（担心被认为摸鱼），老板也有（担心员工摸鱼）。这反过来又会让员工为努力证明他们正在开足马力工作而上演“生产率大戏”。

| “二三四”之城

新冠疫情初期的担忧是人们再也不会回到办公室上班，这是杞人忧天。但希望人们最终能恢复从前的工作习惯又是盲目乐观。事实上，许多员工现在都采取只在周二、周三和周四进办公室的模式。城市还没有对这一趋势做出响应，但到2023年，它们将不得不适应这个“二三四”节奏。在周四晚上，酒吧会挤满互道下周见的上班族。只要调整轮班安排，酒吧就可以相当轻松地适应这种变化。但管理办公室就需要有更多的创意，要么减少人员配置，要么在冷清的日子里为办公室空间寻找其他用途。公交运营商也必须做出调整。它们可以尝试转移需求，在居家办公的日子里提供票价优惠，在周二到周四提高票价，而不是在周一和周五减少发车班次。

| 甜甜圈效应

疫情推动了居家工作的兴起，这意味着办公室离家近没那么重要了，人们现在更加看重家庭空间。斯坦福大学的尼古拉斯·布鲁姆（Nicholas Bloom）和现任本刊记者的阿尔琼·拉玛尼（Arjun Ramani）发现在大城市中存在一种“甜甜圈效应”。随着上班族搬离市中心，郊区的租金飙升，形成了一种环形增长。这个效应得名于中间有个洞的美式甜甜圈。商业地产开发商希望漂亮的写字楼和绝佳的景观等优质设施能吸引人们回到市中心。按照他们的设想，未来的甜甜圈会是英国的那种——中间没有洞，而是填满了果酱。

| 电池带

“锈带”指的是美国自20世纪50年代以来因制造业衰退而陷入困境的那部分地区。为了振兴这些地区，如今人们正在努力推动对新型绿色产业的投资，例如电动汽车制造和生产汽车电池的“超级工厂”。福特正投资500亿美元扩大电动汽车的生产，它的竞争对手通用汽车投资350亿美元，估计将有400亿美元投入这个新“电池带”，用以新建或扩大电池产能。这个词会在2023年流行起来吗？

| 迎毗

邻避一族（NIMBY）不希望在他们的后院建造任何东西，而迎毗（YIMBY）一族对开发的态度则是“尽管来呀”。他们更喜欢高密度的开发，而不是在汽车驱动下不断地扩大城市。迎毗一族已经存在多年，但他们在改变规划规则方面成果有限。这种情况将在2023年发生变化。7月，《经济适用房和高速公路就业法案》（Affordable Housing and High Road Jobs Act）在加州生效。这将让在目前以写字楼、商店和停车场为主的地方建造住宅变得更加容易，并将缓解分区法造成的生活区和工作区严格分离的状态。加州也在放宽要求开发商提供大量停车位的规定。对于靠近公交设施的新开发项目，停车场要求将被放宽，这应该会降低建设成本和房价。加州起头的事，其他地方往往最终都会效仿。

| 虚拟发电厂

越来越多的家庭和企业安装了太阳能电池板和电池，既可以为自己供电，也可以在需要时向电网供电。当成百上千个这样的小型发电和储能系统通过互联网指令一起协同工作时，就相当于有了一个可以根据临时需求随时启动和关闭的虚拟发电厂。用户必须主动做出选择才能让自己的设备参与电网运行，并可根据并入电网的电量获得报酬。

有了虚拟发电厂，就不再需要通过高成本、重污染的“峰值负载发电厂”来维持高峰时段的供电。它们还可以帮助电力公司调节频率和控制电压，这两方面都必须仔细管理好才能平衡供需，特别是在严重依赖太阳能和风能等间歇性能源的电网中。虚拟发电厂是“智能电网”可以推动可再生能源转型的一个例子。澳大利亚、英国、美国加州和德国都已有部署。

| 垂直起降机场

空中出租车，也称为飞行汽车或eVTOL（电动垂直起降）飞行器，本质上就是大到可以载人的多旋翼无人机。全球有几家公司希望这种飞行器能在2023年获得监管部门批准，成为一种可持续的快速城市交通工具。但是eVTOL不能随处起降，而是需要专门的地方，也就是所谓的垂直起降机场——它们既是机场、又是地铁站，让eVTOL得以与现有交通网络（如公路和铁路）接驳。这一切对建筑师和城市设计师提出了新的挑战，他们已经提出了一些别具特色的设计。eVTOL要想腾飞，就一定会需要垂直起降机场。

| 太空太阳能

1941年，艾萨克·阿西莫夫（Isaac Asimov）在科幻小说中提出用装在轨道卫星上的巨大太阳能电池阵列在太空吸收太阳能，然后以微波形式传回地球。自那以来这一想法一直没有被忘记。但这样做在经济上不划算，因为太空发射成本极高。如果发射成本大幅度下降，或者出现了能在小行星上开采原材料等新型太空制造技术，这种情况可能就会发生改变。轨道足够高的话，太阳能发电卫星可以全天处于阳光照射之下，能够提供清洁可靠的能源。欧洲航天局（European Space Agency）于2022年在德国资助了一次地面演示，这是该航天局提出的Solaris计划的一部分。美国、英国、中国和日本也在出资开展相关研究，该领域正迎来新的曙光。

| 地月

美国打算在未来几年内将宇航员送上月球，长期目标是在月球上建立永久基地。作为阿尔忒弥斯（Artemis）计划的一部分，美国打算在月球轨道上建立一个名为月球门户（Lunar Gateway）的空间站，作为通信枢纽、科学实验室和短期生活空间，计划于2024年发射。为该计划做准备的一系列机器人登月任务将于2023年启动。在地球和月球轨道之间的“地月”空间将变得热闹非凡。

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The World Ahead 2023

India will become the world's most populous country in 2023

China is now suffering from a demographic slump

CHINA HAS been the world's most populous country for hundreds of years. In 1750 it had an estimated 225m people, more than a quarter of the world's total. India, not then a politically unified country, had roughly 200m, which ranked it second. In 2023 it will seize the crown. The UN guesses that India's population will surpass that of China on April 14th. India's population on the following day is projected to be 1,425,775,850.

The crown itself has little value, but it is a signal of things that matter. That India does not have a permanent seat on the UN Security Council while China does will come to seem more anomalous. Although China's economy is nearly six times larger, India's growing population will help it catch up. India is expected to provide more than a sixth of the increase of the world's population of working age (15-64) between now and 2050.

China's population, by contrast, is poised for a steep decline. The number of Chinese of working age peaked a decade ago. By 2050 the country's median age will be 51, 12 years higher than now. An older China will have to work harder to maintain its political and economic clout.

Both countries took draconian measures in the 20th century to limit the growth of their populations. A famine in 1959-61 caused by China's "great leap forward" was a big factor in persuading the Communist Party of the need to rein in population growth. A decade later China launched a "later, longer, fewer" campaign—later marriages, longer gaps between children and fewer of them. That had a bigger effect than the more famous one-child policy, introduced in 1980, says Tim Dyson, a British demographer. The decline in fertility, from more than six babies per woman in the late 1960s

to fewer than three by the late 1970s, was the swiftest in history for any big population, he says.

It paid dividends. China's economic miracle was in part the result of the rising ratio of working-age adults to children and oldsters from the 1970s to the early 2000s. With fewer mouths to feed, parents could invest more in each child than they otherwise would have. But having more parents than children, an advantage when the children are young, is a drawback as the parents age. The country will now pay a price as the economic-boomer generation retires and becomes dependent on the smaller generation following behind it.

India's attempt to reduce fertility was less successful. It was the first country to introduce family planning on a national scale in the 1950s. Mass-sterilisation campaigns, encouraged by Western donors, grew and were implemented more forcefully during the state of emergency declared by Indira Gandhi, the prime minister, in 1975-77. Under the direction of her son Sanjay, the government forced men into vasectomy camps on pain of having their salaries docked or losing their jobs. Policemen nabbed poor men for sterilisation from railway stations. Around 2,000 men died from bungled procedures.

Forced sterilisations ended after Indira Gandhi lost an election. Though brutal, the campaign was not thorough enough to cause a dramatic drop in India's birth rate. India's fertility has dropped, but by less, and more slowly than China's. With a median age of 28 and a growing working-age population, India now has a chance to reap its own demographic dividend. Its economy recently displaced Britain's as the world's fifth-biggest and will rank third by 2029, predicts State Bank of India. But India's prosperity depends on the productivity of its youthful people, which is not as high as in China. Fewer than half of adult Indians are in the workforce, compared with two-thirds in China. Chinese aged 25 and older have on average 1.5

years more schooling than Indians of the same age.

That will not spare China from suffering the consequences of the demographic slump it engineered. The government ended the one-child policy in 2016 and removed all restrictions on family size in 2021. But birth rates have kept falling. China's zero-covid policy has made young adults even more reluctant to bear children. The government faces resistance to its plans to raise the average retirement age, which at 54 is among the lowest in the world. The main pension fund may run out of money by 2035. Yet perhaps most painful for China will be the emergence of India as a superpower on its doorstep.

Brooke Unger: Senior digital editor, The Economist ■



世界展望2023

印度将在2023年成为世界上人口最多的国家

中国正在遭受人口衰退的影响

数百年来，中国一直是世界上人口最多的国家。1750年，中国估计有2.25亿人口，超过世界总人口的四分之一。印度当时还不是一个政治统一的国家，拥有大约2亿人口，排名第二。2023年它将夺冠。联合国预测，印度人口将在4月14日超过中国。第二天的印度人口预计为1,425,775,850人。

这个第一本身没有什么价值，但它是一些重要事物的信号。印度在联合国安理会没有常任理事国席位而中国有，这将显得更加反常。尽管中国的经济规模接近印度的七倍，但印度不断增长的人口将帮助它迎头赶上。从现在到2050年，预计世界劳动年龄（15-64岁）人口增长的超过六分之一将来自印度。

相比之下，中国人口将急剧下降。中国的劳动年龄人口在十年前达到顶峰。到2050年，该国的中位年龄将达到51岁，比现在高12岁。一个更高龄的中国将不得不更加努力地工作以维持其政治和经济影响力。

两国在20世纪都采取了严厉的措施来限制人口增长。1959至1961年中国“大跃进”引发的饥荒是促使共产党相信需要控制人口增长的一个重要因素。十年后，中国发起了一场“晚、稀、少”的运动——晚婚、拉长生育间隔，生更少的孩子。英国人口学家蒂姆·戴森（Tim Dyson）表示，这一政策的影响超过了1980年推出的更为著名的独生子女政策。他说，从1960年代后期的每名妇女生育6个以上到70年代后期的不到3个，生育率的下降速度在人口大国中是史无前例的。

这带来了红利。中国经济奇迹的部分原因是从1970年代到2000年代初，适龄工作的成年人相对于儿童和老人的比例不断上升。由于需要养活的人口变少了，父母可以在每个孩子身上投入更多的钱。但是，父母数量多于孩子，这在孩子小的时候是一个优势，但随着父母年龄的增长就变成了劣

势。随着经济繁荣一代退休并开始依赖之后人数更少的一代，中国现在将付出代价。

印度降低生育率的尝试不太成功。1950年代时，它是第一个在全国范围内实行计划生育的国家。1975至1977年，在总理英迪拉·甘地（Indira Gandhi）宣布的紧急状态期间，在西方捐助者的鼓励下，大规模绝育运动得到了发展和更强力的实施。在她的儿子桑杰（Sanjay）的指示下，政府强迫男性进入输精管切除术营地，否则工资就会被扣减或失去工作。警察从火车站逮捕穷人施行绝育。大约2000人死于拙劣的手术。

强制绝育在英迪拉·甘地竞选连任失败后结束。虽然残酷，但这场运动还不够彻底，无法使印度的出生率急剧下降。印度的生育率下降了，但降幅小于中国，而且下降速度比中国慢。现在，凭借28岁的中位年龄和不断增长的劳动年龄人口，印度有机会收获自己的人口红利了。印度国家银行预测，印度最近取代英国成为世界第五大经济体，到2029年将排名第三。但印度的繁荣取决于其年轻人的生产力，这一水平不如中国。印度只有不到一半的成年人进入劳动力市场，而在中国这一比例为三分之二。25岁及以上的中国人受教育时间平均比同龄印度人多1.5年。

这并不能使中国免于遭受它一手造成的人口衰退的后果。政府在2016年结束了独生子女政策，并在2021年取消了对家庭规模的所有限制。但出生率一直在下降。中国的清零政策让年轻人更不愿意生孩子。政府提高平均退休年龄的计划面临阻力，而54岁是世界上最底的退休年龄之一。到2035年，主要的养老基金可能会耗尽。然而，对中国来说，最大的痛苦可能是邻居印度作为超级大国的崛起。

布鲁克·昂格尔：《经济学人》高级数字编辑 ■



The Economist explains

How to design a perfect World Cup

Balance fairness, global representation and opportunities for drama

THERE MAY never be another World Cup as intimate as this one. Since 1998 each tournament has featured 32 teams. In 2026, 48 will compete. Not everyone is keen: many fans and pundits fear that the expansion will dilute quality; others question how the entrants can be fairly winnowed down without making the tournament too long. FIFA, football's global governing body, says it is still considering the structure of the competition. How could it design the perfect tournament?

The first problem is deciding which teams can compete. The primary goal of the World Cup is to find the best team. But FIFA also sees it as an opportunity to develop the game. That is why Europe has only 13 of the 32 current spots, despite having 16 of the world's top 32 teams. In the expanded line-up the balance will tilt further towards global representation, with the number of Asian and African teams nearly doubling. Europe will get three more spots, but its share will fall from around 40% to a third.

Next FIFA must decide how to determine the best team among the 48. The fairest solution is the round-robin system used in domestic football leagues: every team plays every other, yielding a full ranking from first to last. But that would be impractical for a one-month competition: 48 teams would play 1,128 matches (meaning 36 each day). It would also deny fans the drama of a marquee final.

The other extreme, a straight knockout tournament, would require far fewer matches. A 32-team event would need 31 matches to identify a champion (compared with 64 games in this year's cup, including the third-

place playoff). But it would waste time and money for half of the teams—and their fans—to travel to the tournament to play a single match. And great teams that have bad matches early on deserve a reprieve. One of this year’s finalists, Argentina, lost their opening game to Saudi Arabia. That is why World Cups in most sports feature a group stage, where teams are sorted into mini-leagues, with a certain number then qualifying for knockout matches. This reduces randomness while allowing scope for upsets (see Morocco’s run to the semi-final at this year’s World Cup).

The problem with FIFA’s planned expansion is that 48 is an unwieldy number. With 32 teams the maths are easy: eight groups of four each yield two qualifiers for the knockout stage. But with 48 it will be hard to arrive neatly at the required 32 or 16 (both powers of two). FIFA’s current thinking is to have 16 groups of three, with the best two from each qualifying for a knockout round of 32. But this could render more of the final round of group games meaningless, with the top two positions already decided. Worse, it could provide an opportunity for collusion—if, say, two teams playing each other knew a draw would see them both qualify at the expense of the hapless third that was sitting the final round out.

Another solution could be 12 groups of four. The top two from each would qualify for the round of 32, along with the eight best third-place finishers. A similar format is used in the European Championships. But it would mean 24 more World Cup games than in 2022, and the choice of the “best” third-placed teams (eg, on goal difference) may potentially be unfair.

A more radical approach could be the “Swiss system”, a tournament format used for chess and other board games. It is in essence a league with fewer matches. Competitors do not play everyone else. Instead, after every round, they are drawn against similarly performing counterparts. Winners play winners, but those who lose still have a chance to redeem themselves and climb up the league table. According to a study by Laszlo Csato and his

colleagues at the Corvinus University of Budapest, this format is the most effective at ranking teams within a short period. Starting in 2024, the Champions League, European club football's most prestigious tournament, will deploy a variation of the Swiss system to cut down 36 teams to a knockout round of 16.

Doing something similar for the World Cup would mean splitting the 48 teams into big groups (four groups of 12, for example) and using the Swiss system to identify who came top. The difficulty would lie in ensuring that each group was of a similar quality and then identifying the right fixtures for every round to ensure that every team faced a similar challenge to qualify for the knockout. Fans and teams grumble about group draws as it is. A situation where some teams face apparently easier opponents within their group could trigger fury.

Whatever FIFA decides will feel awkward, especially after the simplicity of the 32-team format. But that will be temporary—football fans are a malleable lot. In the 15 World Cups up to 1998, the format changed almost every other tournament. That did little to dampen interest. The fans seeing their teams play for the first time in an expanded World Cup will not complain. ■



学人解惑

如何设计一个完美的世界杯赛制

要平衡公平性、全球参与和戏剧性

或许再也不会会有哪届世界杯能像本届这样紧凑的了。自1998年以来，每届世界杯的参赛球队都是32支。2026年将会增加到48支。并非人人都乐见世界杯扩军：许多球迷和专家担心这会降低比赛质量；还有人质疑如何才能让参赛队伍公平晋级而又不会把赛程拉得过长。全球足球管理机构国际足联（FIFA）表示现在仍在考虑下一届世界杯的赛制。它怎样才能设计出完美的世界杯？

首先是决定哪些队伍可以参赛。世界杯的首要目标是选出最好的球队，不过国际足联也认为这是个发展足球运动的机会。这就是为什么在本次世界杯的32支参赛队伍中，欧洲只有13支，而它们在今年世界排名前32的球队中却有16支。扩充后的阵容将更加注重全球参与，届时亚洲和非洲球队的数量差不多会翻一番。欧洲将增加三个席位，但其所占席位将从40%左右下降到三分之一。

接下来，国际足联必须决定如何从48支球队中决出冠军。最公平的办法是各国足球联赛采用的循环赛：每支球队要与其他各支球队进行一场比赛，所有球队按积分从高到低排名。但这对于一个为期一个月的杯赛来说不切实际：48支球队要踢1128场比赛（也就是每天36场）。这也会使得球迷再也享受不到决赛大戏的精彩刺激。

另一个完全相反的办法是直接进行淘汰赛，这样比赛场次就会少得多。照此办法，32支球队只需31场比赛就能决出冠军（今年的世界杯包括三四名决赛在内有64场比赛）。但这样一来，就有一半的球队耗时费钱前去参赛却只能踢一场，对它们的球迷来说也是一样的问题。而且，在刚开赛时表现不佳的强队应该有暂缓出局的机会。比如今年入围决赛的阿根廷队就在首场比赛中输给了沙特阿拉伯队。这就是为什么大多数体育项目的全球性赛事都设有小组赛——球队被分到不同的小组，之后一定数量的球队晋级

淘汰赛。这减少了随机性，同时也保留了爆冷的空间（如摩洛哥在今年世界杯冲进了半决赛）。

国际足联扩军计划的问题在于48这个棘手的数字。32支球队安排起来很简单：分成八组，每组四支球队，前两名进入淘汰赛。但48支就很难正好产生所需要的32或16支（都是2的幂数）。国际足联目前的想法是把48支球队分成16个小组，每组三支球队，小组前两名进入32强的淘汰赛。但这可能会让更多最后一轮小组赛失去意义，因为前两名的位置已经确定。更糟糕的是，或许还会有队伍借机踢默契球——比如说，如果两队知道打成平局就能同时晋级，它们就会联手牺牲掉在最后一轮轮空的那一队。

另一种解决方案是分成12组，每组四支球队。每个小组的前两名加上八支成绩最好的小组第三名晋级32强。欧洲杯就采用了类似的赛制。但这意味着比赛场次会比今年这届多24场，而且选择“成绩最好的”小组第三（比如通过比较净胜球）的过程可能会不公平。

一种更激进的方法可能是国际象棋和其他棋类游戏的锦标赛所采用的“瑞士赛制”。它本质上是个联赛，只是比赛场次少些。参赛者不需要与所有对手都比一次，而是在每轮比赛结束后，与表现差不多的对手一起抽签。赢家和赢家比赛，但输家仍然有补救机会来提升自己的排名。根据布达佩斯科维努斯大学（Corvinus University of Budapest）的拉斯洛·乔托（Laszlo Csato）和同事的一项研究，这是在短期内给团队排名的最有效的方法。从2024年开始，欧洲俱乐部足球最负盛名的赛事——欧冠将采用一种从瑞士赛制演变而来的赛制，从36支球队中决出16强进入淘汰赛。

如果世界杯上也采用类似做法，就意味着要把48支球队分成几个大组（比如四组，每组12队），并采用瑞士赛制来决选出冠军。这么做的难点在于确保每个小组的水平相当，随后为每轮比赛确定最合适的赛程也是个难点，因为要确保每支球队在晋级淘汰赛的道路上都会面对难度相似的挑战。球迷和球队本来就对目前的小组抽签多有抱怨。如果一些球队在分组中遇到明显更容易对付的对手，就可能引发其他队伍的怒火。

无论国际足联做出什么样的决定，都会让人感到不适应，尤其因为之前是这种32队的简单模式。但这也只会是暂时的，因为球迷的可塑性很强。在1998年之前的15届世界杯中，赛制几乎每隔一届就有所改变，而这并没有降低人们的兴趣。当球迷们看到自己的球队首次出现在扩容后的世界杯中，怨气也就消了。■



A brouhaha about fusion

Controlled fusion is little nearer now than it was a week ago

Despite excited reports, the NIF's announcement will not lead to civil fusion reactors

ON DECEMBER 13TH America's energy secretary, Jennifer Granholm, announced that the country's National Ignition Facility (NIF) had lived up to the "I" in its name, by achieving ignition. The stuff ignited was some pellets of a frozen mixture of deuterium and tritium—isotopes of hydrogen that have, respectively, one and two neutrons in their nuclei in addition to the single proton that is hydrogen's nuclear characteristic.

That an American cabinet member should make time in her diary to grace the announcement of an arcane result in physics is odd. But so is the whole episode. For the result in question has been the centre of a media storm, starting on December 11th with an article in the Financial Times, based, apparently, on a leak from NIF, and followed by a hurricane of publicity when the actual moment came.

"US researchers have overcome a major barrier to achieving low-carbon nuclear fusion," gushed the BBC's website, leaving the reader wondering if there is also a high-carbon variety of fusion. The Wall Street Journal went with, "Nuclear-fusion breakthrough accelerates quest to unlock limitless energy source." Svenska Dagbladet, one of Sweden's leading dailies, wrote, "We are one step closer to unlimited energy." La Repubblica, one of Italy's, pronounced that, "The dream of a clean, renewable and safe source [of energy] is approaching."

Well, we aren't. And it isn't. Or, if it is, that has little to do with recent events in Livermore, California, where NIF is located. The result Ms Granholm attached herself to is interesting. But a useful step towards electricity generation by fusion it is not.

NIF is part of Lawrence Livermore National Laboratory, the main purpose of which is to investigate the physics of hydrogen bombs. These work by compressing deuterium and tritium atoms together so tightly that their nuclei fuse to create a helium nucleus, a neutron and some energy. Do this to enough pairs of atoms and you get a lot of energy—and a big bang.

Some years ago, therefore, in the wake of America's abandonment in the 1990s of the testing of nuclear weapons, a group of bright sparks at Livermore thought useful experiments might still be carried out by developing a technology called inertial confinement, to do something similar on a far smaller scale. Thus was NIF born.

| *Ignition sequence start?*

In a bomb, the compression is done by a fission explosion involving plutonium. In one of NIF's pellets it is done by the convergence on the pellet of 192 beams from a powerful laser. In both cases the aim is to overcome the mutual electrical repulsion of the positively charged nuclei of the atoms, and push those nuclei close enough to one another for a different fundamental force, the strong nuclear force (which operates only at short ranges) to take over.

The strong force is attractive, not repulsive. It pulls the protons and neutrons of the parent nuclei together into a heavier, daughter nucleus. That daughter requires less energy to bind it than do the parents, so the surplus is released—80% of it as kinetic energy of the departing neutron and 20% as kinetic energy of the helium.

The basis of the razzamatazz is that the NIF's researchers have released more energy from an imploding pellet than was inserted by the laser beams. They have, in other words, ignited a nuclear spark which burned for a while through the pellet in a self-sustaining way—something never before achieved. And that might be scaled up to release a far bigger fraction

of the potential energy in the pellet's contents.

Neat, in principle. And no doubt important for understanding hydrogen bombs. But this approach can be a power source only if the energy released exceeds not merely that incident on the pellet, but rather that employed to generate the beams. Unfortunately, the huge inefficiencies involved in creating those beams mean only a tiny fraction of the generative energy behind them arrives at the pellet. Not really the basis for a workable reactor. And that is before you factor in all the other engineering difficulties involved in transducing the kinetic energy of the fusion products into electricity.

| *Too cheap to meter?*

Fusion, though, presses odd buttons in people's psyches. The supposedly limitless supply of fuel (for deuterium occurs naturally in a small fraction of water molecules) is touted as a benefit—conveniently ignoring the fact that tritium, which is radioactive and has a half-life of 12 years, has to be synthesised. And the observation that it releases no CO₂ is true also of nuclear fission, solar energy and wind power, all of which are actual, developed technologies.

Yet, in this case, things are even odder. After decades when, to quote an old joke, “fusion power is 30 years away—and always will be”, there are now real ideas and real firms with real money pursuing it in the private sector. Few of these projects involve the fiddly technology of inertial confinement by laser. Even lasers more modern than that used by NIF (which opened in 2009) have not overcome the inefficiencies inherent in the process of “pumping” the device to create the beam.

Instead, many commercial projects are based on tokamaks—an established approach that goes back to the 1950s. This heats the deuterium-tritium mixture into a plasma rather than freezing it into a pellet, and does the

compressing magnetically. Breakthroughs in magnet technology, in particular, have enabled this renaissance.

The private sector being what it is, wilder ideas still are out there, too—from different fuel cycles involving different nuclei to a form of inertial confinement that works by firing a projectile into a fuel-rich target, rather than aiming laser beams at it. In light of all this, it seems inconceivable that the future of commercial fusion power, if it has one, lies with inertial-confinement by laser. Remember that, next time the headline writers get carried away. ■



关于核聚变的喧嚣

相比一周前，可控核聚变技术并没有多大进展

尽管报道热烈，但NIF的公告并不会造就民用核聚变反应堆【新知】

十二月十三日，美国能源部部长詹妮弗·格兰霍姆（Jennifer Granholm）宣布，美国国家点火装置（National Ignition Facility，以下简称NIF）成功实现了核聚变点火，无愧于它名字中的“点火”二字。被点燃的是包含氘和氚的低温冷冻靶丸，两者为氢的同位素，和氢一样在原子核内含有一个质子，但所含中子数不同，氘有一个，氚有二个。

一名美国内阁要员拨冗来盛大宣布一项高深晦涩的物理学研究结果，这有点反常。而整件事也同样奇怪。12月11日《金融时报》发表了一篇看起来是基于NIF透露的信息的文章，之后这项研究成果便成了一轮媒体风暴的中心，一直到成功点火的那一刻，又掀起一场宣传飓风。

“美国研究人员已经克服了实现低碳核聚变的一个重大障碍。”在自家网站上，BBC的兴奋溢于言表，令读者不禁疑惑核聚变是否还有高碳版本。

《华尔街日报》则称：“核聚变的这一突破加速了解锁无限能源的探索。”瑞典主要日报之一《瑞典日报》（Svenska Dagbladet）写道：“我们离无限能源又近了一步。”意大利的《共和报》（La Repubblica）宣称：“清洁、可再生、安全的[能量]来源的梦想快要实现了。”

呃.....我们并没有接近目标。这个梦也不是就快要实现了。或者说，就算快实现了，也和最近在加州利弗莫尔（Livermore，NIF的所在地）发生的事情没什么关系。格兰霍姆出面宣布的这个结果很有意思，但并非实现核聚变发电的有用的一步。

NIF隶属于主要做氢弹物理研究的劳伦斯利弗莫尔国家实验室（Lawrence Livermore National Laboratory）。氢弹的原理是把氘和氚原子挤压聚合，通过核聚变反应生成一个氦原子核和一个中子，并释放能量。让足够多的氘氚原子发生这样的反应就能得到大量能量，也会产生大爆炸。

因此，尽管美国在上世纪90年代放弃了核武器试验，若干年前，利弗莫尔的一群顶尖科学家认为或许仍可以通过研发名为“惯性约束”的技术，以小得多的规模继续开展有用的试验。于是NIF诞生了。

| 点火时序启动？

在核弹中，挤压聚合是通过钚的裂变爆炸实现的。在NIF的氘氚靶丸里，则是用强大的激光器把192道激光聚焦在靶丸上完成。两种做法都是为了克服带正电的原子核之间相互排斥的电磁力，让这些原子核靠得足够近，从而产生另一种基本作用力——强核力（只在极短距离内起作用）。

强核力是吸引力，不是排斥力。它能使母核的质子和中子聚合，形成一个质量更重的子核。与母核相比，子核聚合所需能量更少，因此多余的能量会被释放，其中80%是分离出中子的动能，20%是氦核的动能。

媒体大肆吹捧，理由是NIF研究人员已成功使氘氚靶丸内爆释放的能量高于入射激光束的能量。换句话说，他们已经点燃一束核火花，通过氘氚靶丸聚变实现了一段时间的自持燃烧，这是前所未有的成果。也许可以扩大规模，更大程度释放靶丸中燃料的潜在能量。

理论上来说，这很棒。而且毫无疑问，这对理解氢弹原理很重要。但要成为一种能量源，释放的能量仅仅超过射入靶丸的能量还不够，还要大于生成激光束所耗费的能量才行。遗憾的是，用以生成激光束的能源利用效率极低，以致最终只有很小一部分能量射入靶丸。因此并不足以据此建立可行的反应堆。而且这还没算上把核聚变产物的动能转化为电能涉及的其他工程难题。

| 便宜到不用计费？

不过，核聚变让人生发出某些奇想。由于氘自然存在于小部分水分子中，让人联想到核聚变燃料可以无限供应，并把这当作优点大加推崇，而轻描淡写地忽略掉另一个事实：氚具有放射性，半衰期为12年，需要人工合成。核聚变确实不释放二氧化碳，但核裂变、太阳能和风能这类切实而成熟的技术也都能做到。

但说到这，事情更奇怪了。几十年来，一个老梗是这么说的，“核聚变发电离我们还有30年，而且永远都有这么久”。如今，私营部门终于有了真正的想法，成立了真正的公司并投入真金白银来追寻这个目标。这些项目很少研究激光惯性约束聚变这项复杂的技术。即使是比NIF（2009年启用）更先进的激光装置也还没能克服“泵浦”激光时固有的低效率问题。

相反，许多商业项目的基础都是源于上世纪50年代的成熟方法——托卡马克装置。这种技术把氘氚混合物加热成等离子体而非冷冻成靶丸，然后用磁力完成聚变。如今的技术突破，尤其是磁力技术的突破，促进了托卡马克装置的复兴。

私营部门就是这样，永远不缺更疯狂的想法，例如利用不同核子来建立其他燃料循环，或者尝试另一种惯性约束聚变，向含有燃料的目标发射弹丸而非激光束。鉴于这一切，似乎无法想象未来的商用聚变发电（如果能实现的话）会依赖激光惯性约束。下次新闻头条的作者们又忘乎所以时，要记得这一点。■



Naval drones

Ukrainian ingenuity is ushering in a new form of warfare at sea

Are uncrewed attack vessels the wave of the future?

ON SEPTEMBER 21ST an odd piece of flotsam washed up on the outskirts of Sevastopol. It was about five and a half metres long and the consensus was that it was a USV (uncrewed surface vessel, essentially a drone boat), possibly on a reconnaissance mission, that had been put together by the ingenious boffins who are to Ukraine what Q branch is to James Bond.

On October 29th reality bit. A fleet of the things, accompanied by similarly robotic air cover, attacked Sevastopol's naval base, the home port of Russia's Black Sea fleet. According to the Ukrainians, and backed up by video footage apparently shot from cameras on board one of the drones, they scored direct hits on Admiral Makarov, the fleet's flagship, and two other vessels, damaging all three. That was followed on November 18th by a big explosion at a Russian oil terminal in Novorossiysk, also reported to have been the work of the same type of naval drones.

"For many it [these attacks] marks the start of a new age in naval warfare," wrote H.I. Sutton, an author, blogger and naval analyst who has studied footage of the Ukrainian drone boat. That could be bad news not only for Russia, but for anyone who does business, naval or civilian, at sea. For its part, Ukraine announced on November 11th that it plans to build 100 of the vessels, paid for, it hopes, by crowdfunding.

| *Enemy in sight*

Until Ukraine's attack on the Black Sea fleet, strapping bombs to remote-controlled boats had mostly been the preserve of irregular forces. Iran did test some in 2017, against a Saudi Arabian tanker. But things really got going when the Houthi movement, a group of rebels against Yemen's Saudi-

supported government, began, with apparent Iranian support, to use uncrewed speedboats stuffed with explosives. Also in 2017, one of these hit Al Madinah, a Saudi Arabian frigate, in the Gulf. The explosion killed two sailors. Since then, according to data compiled by Harvard Haugstvedt of Oslo University's Centre for Research on Extremism, the group has launched more than 20 further attacks on commercial ships and shore facilities.

Partisans' drones are also going underwater. In 2021 Israel's navy destroyed what it described as a bomb-carrying submersible drone minutes after its launch into the Mediterranean by members of Hamas. According to Israel, Hamas has been honing the technology for years. Each vessel, it claims, can carry about 30kg of explosive.

Efforts by governments to weaponise uncrewed boats have generally taken a different tack. Rather than packing vessels with bombs and ramming them into their targets, the world's navies seem more interested in mounting guns and missiles on USVs and using them like any other warship, only without sailors on board. As far back as 2012, for example, America's navy was experimenting with a rigid-hull inflatable boat equipped with missiles and a remotely operated machine gun. In coming years, it plans to spend billions of dollars developing a colourful array of USVs, some of which may be as long as a superyacht and capable of carrying long-range missiles and other weapons.

China has sought to keep pace, with numerous programmes that mirror America's efforts. One of these—a heavily armed vessel called the JARI—has made regular appearances at weapons shows across the world, complete with mock-up guns and torpedoes. That suggests China is interested in exporting the technology as well as using it itself.

In Israel, meanwhile, Rafael, a government-owned armaments company,

has spent years perfecting a speedy USV called the Protector. In 2017 it decked one out with Spike anti-tank missiles and later demonstrated it in a NATO live-fire exercise. And EDGE, a state-owned Emirati conglomerate, is collaborating with IAI, another Israeli firm, to build a similar vessel.

Elsewhere, Britain has, since 2019, been developing such capabilities through its NavyX project, which it describes, with refreshing honesty, as an “Autonomy and Lethality Accelerator”. Greece, Portugal, Singapore, South Korea and Turkey have also been rolling out armed USVs.

| *Keeping a low profile*

All these projects, though—at least, all that are known of—have a slightly unimaginative feel to them. They are to the world of naval warfare what machines like the Predator and Reaper drones made by General Atomics are to aerial combat, namely redesigned, uncrewed versions of the existing way of doing things. What Ukraine seems to have demonstrated is the naval equivalent of the quadcopter. And that may make naval warfare asymmetric in a way which governments are unprepared to deal with.

None of the Ukrainian boat’s underlying technologies would be out of reach for a small military power or a reasonably competent non-state group. According to an analysis by Mr Sutton of available images, its engine appears to be from a Sea-Doo jet ski. Its bow-mounted camera looks like a device that cyclists might strap to their helmets (it has a larger one, pictured, mounted amidships). And its satellite receiver bears a strong resemblance to the Starlink terminals supplied by SpaceX.

In its fundraising materials, Ukraine claims that each boat costs a mere \$250,000. A single anti-ship missile, by comparison, can cost millions. Ukraine will get a lot of bang for those bucks. The boat’s cargo bay can carry 200kg of high explosive to a ship’s waterline where—unlike a hole punched higher up in a hull by a missile or aerial drone—it will cause the vessel hit

to ship water and possibly sink.

Uncrewed surface vessels thus seem poised to follow the trajectory of airborne commercial drones, which caught governments flat-footed when they went from hobby-shop curiosity to deadly security threat seemingly overnight. Scott Crino, whose company, Red Six Solutions, advises governments on how to protect themselves from aerial-drone incursions, says that for years he has been telling officials that the prospect of malicious maritime-drone use is a risk. “The typical response,” he says, “is a head nod.”

Navies should not be the only ones to worry. Commercial shipping is at particular risk, as the Houthi attacks show. Security measures on merchant vessels are usually predicated on discouraging the crews of attacking boats with non-lethal measures like long-range acoustic devices, floodlights and water cannons, together with barbed wire to repel boarders. Some ships do sail with armed guards, but their small-calibre weapons would be hard put to stop a reinforced drone boat whipping across the waves, according to Mr Crino.

Coastal infrastructure is also at risk. Six of the recorded Houthi assaults were on civilian ports and oil terminals. One of these caused “significant damage” to a Singaporean tanker, according to America’s State Department. If confirmed as the work of a boat drone, Ukraine’s attack on Novorossiysk would be ample proof that any waterfront structure, no matter how heavily secured, could be a target.

Not having a crew gives USVs other advantages. With no need for a cabin, they can be built for stealth. The Ukrainian boat rises only a few centimetres above the water’s surface, making it almost invisible to radar and cameras—but, unlike a submarine drone, still able to keep in radio contact with its controllers. (Radio waves cannot penetrate water.) This

does not mean a follow-up could not dive completely underwater, for example in order to evade detection on a final attack run, like a German U-boat. The Hamas subs, which are guided on the surface by GPS, might already operate on a similar principle.

Skipping the crew also means vessels can be used more brazenly. A group planning a kamikaze-style maritime attack can avoid relying on a human “who may lose their nerve at the last second”, as Scott Savitz, a senior engineer at the RAND Corporation, puts it. In the footage from the attack on Sevastopol, the drone charges through a hail of gunfire with gay abandon.

How, then, do you stop a USV? The immediate response has been to rejig existing weapons. A couple of years ago Thales, a French armaments firm, thus reconfigured its supersonic Martlet missile to hit small fast-moving surface vessels. The result will be fitted to British frigates in 2024.

America’s navy also recently put the finishing touches to what it calls a “Surface Warfare Mission Package”, consisting of two 30mm guns, two rigid-hull inflatable boats and a helicopter. This, it says, is specifically geared toward picking off small fast-moving boats, both crewed and uncrewed.

Moving beyond such lash-ups, both America and Britain have toyed with lasers which they claim could do the job. But it is unclear whether that technology is ready. The American test, aboard the USS Portland in the Gulf of Aden, was against a stationary target. Those British tests so far disclosed have taken place on land.

A popular technique for bringing down aerial drones is to jam their radio links with high-intensity electromagnetic chatter, or to wrest control of the craft itself through a technique known as “spoofing”. This might work for USVs, too—though countermeasures, in the form of encrypted links and increased autonomy, are becoming increasingly effective, says Mr Crino.

| *I contain multitudes*

Another proposal, albeit so far imaginary, is to fight drone with drone. A retinue of uncrewed air and sea vehicles could serve as “scouts and bodyguards”, as Mr Savitz puts it, to scan the horizon for incoming USVs and attack them if needed. In June, Britain’s defence ministry awarded an urgent contract to BAE Systems, another armaments company, for an aerial-reconnaissance drone to deploy aboard frigates “to counter unmanned surface vessels”. (A spokesman noted that the navy is working to address “new threats across a range of environments”, but declined to provide specific details on any of its counter-drone boat efforts.)

As is often the case when a new threat emerges from the technological shadows, armed forces will also look for answers in unusual places. First-world-war-style indicator nets for ensnaring submersible and semi-submersible craft could see a return to service. And Mr Savitz points to an American programme, inspired by the defensive secretions of hagfish, to develop a slime that could be used to gunk up the propellers of incoming USVs.

But no amount of firepower, nor tide of gloop, is likely to be a satisfactory response on its own. “By the time you’re getting into the range of a point defence system,” says Craig Allen, a commander in America’s coast guard, “it’s pretty late in the game to try and stop something.” Early detection will thus be crucial—though Mr Crino notes this could be hard in congested areas, such as ports or busy shipping lanes.

Also, these measures assume drone boats will come as single spies. More likely, they will arrive as battalions. “Truthfully it’s pretty hard to stop one hostile incoming target,” says Mr Allen, “and every additional target you add to that makes the problem much more complicated.”

All the more so if a flotilla’s boats can collaborate without reference to

human beings. This is not a distant prospect. Such swarming capabilities have been under development in the West for a while and are beginning to proliferate. Aselsan, a Turkish arms-maker, recently unveiled the Albatross-S, a speedy USV which, it says, can operate in droves that share information about targets and objectives. Meanwhile, engineers at China's College of Weaponry Engineering in Wuhan are building "hunting algorithms" intended to enable swarms of USVs to chase down a multitude of targets, in the manner of a pod of killer whales pursuing a bob of seals. Good luck stopping those with a net. ■



海上无人艇

乌克兰人的聪明才智正在引领一种新型海战

无人攻击艇是未来的浪潮吗？【深度】

九月二十一日，一块奇怪的东西被冲上了塞瓦斯托波尔（Sevastopol）郊区的海滩。它长约五米半，人们都认为它是一艘USV（无人水面艇，本质上就是一艘无人驾驶的船），可能在执行侦察任务，它出自于乌克兰聪明的军事研究人员之手，他们就像是007提供装备的“Q部门”。

10月29日，来真格的了。在无人机的空中掩护下，一个USV编队袭击了俄罗斯黑海舰队在塞瓦斯托波尔的母港。根据乌方的说法，无人艇直接击中了黑海舰队的旗舰“马卡洛夫海军上将”号和另外两艘舰艇，这三艘军舰均有受损。貌似由一架无人机上的摄像头拍摄的视频也支持乌方的说法。11月18日，俄罗斯新罗西斯克（Novorossiysk）的石油码头发生大爆炸，据报道也是同类型的海军无人艇造成的。

“对许多人来说，（这些攻击）标志着一个海战新时代的开始。”作家、博主和海军分析师H.I.萨顿（H.I. Sutton）在研究了乌克兰无人艇的视频后写道。这不仅对俄罗斯来说可能是个坏消息，对任何在海上从事军事行动或民用业务的人来说也都是。乌克兰11月11日宣布一项计划，希望通过众筹建造100艘无人艇。

| 敌军出现

在乌克兰袭击黑海舰队之前，把炸弹绑在遥控船只上主要是非正规武装的做法。伊朗在2017年就拿一艘沙特阿拉伯油轮开过刀。但等到胡塞武装（一个反对受沙特支持的也门政府的叛乱组织）看起来是在伊朗的支持下开始使用装满炸药的无人驾驶快艇，这种操作才真正开始成气候。同样在2017年，这样一艘无人艇在波斯湾袭击了沙特的“阿-麦地纳”号（Al Madinah）护卫舰。爆炸造成两名水兵死亡。根据奥斯陆大学（Oslo University）极端主义研究中心（Centre for Research on Extremism）的哈佛·豪格斯特维特（Harvard Haugstvedt）编制的数据库，自那之后，胡塞

武装又对商船和岸上设施发动了20多起无人艇袭击。

游击组织的无人艇也开始潜入水下。2021年，以色列海军称哈马斯成员在地中海发射了携带炸弹的无人潜水艇，但发射几分钟后就被以军摧毁。以方称，哈马斯多年来一直在打磨这项技术。据称每艘无人潜水艇可携带约30公斤炸药。

各国政府在把无人艇武器化方面普遍采取了另一种思路。比起在USV上装满炸弹然后操控它们撞向攻击目标，世界各国的海军更感兴趣的似乎是给USV安上枪炮和导弹，像使用常规舰艇那样使用它们，只不过不配置水兵。例如，早在2012年，美国海军就在试验配备了导弹和遥控机枪的刚性船体充气艇。未来几年，美国海军计划斥资数十亿计美元开发一系列USV，其中一些可能和超级游艇一样长，能够携带远程导弹和其他武器。

中国试图跟上步伐，推出了许多与美国的无人艇计划相似的项目。其中一个项目是全副武装的JARI无人艇，经常配上模型枪和鱼雷在世界各地的军火展上亮相。这表明中国除了自用，也有兴趣出口这项技术。

与此同时，在以色列，国有军火公司拉斐尔（Rafael）用多年时间完善了一种名为保护者（Protector）的快速USV。2017年，该公司给一艘保护者配备了长钉反坦克导弹，后来在北约的一场实弹演习中进行了展示。阿联酋的国有武器制造集团EDGE正在与另一家以色列公司IAI合作打造类似的无人艇。

其他国家也有相应的研发。自2019年以来，英国一直在通过其NavyX项目研发无人艇，英国难得直白地称这是一款“自主性杀伤加速器”（Autonomy and Lethality Accelerator）。希腊、葡萄牙、新加坡、韩国和土耳其也在推出武装USV。

| 保持低调

不过，所有这些项目——至少是所有已知的项目——都给人一种稍稍缺乏想象力的感觉。无人艇之于海战，就像通用原子公司（General Atomics）制造的捕食者（Predator）和死神（Reaper）之类的无人机之于空战，也

就是对现有的作战方式进行无人化再设计。乌克兰展示的似乎是舰船版的四轴飞行器。这可能会让海战变得实力不对等，很多政府还没有做好准备。

对于小型军事力量或具有一定能力的非国家组织来说，乌克兰无人艇所用的底层技术都不是遥不可及的。根据萨顿对可用图像的分析，这种无人艇似乎用的是Sea-Doo摩托艇的引擎。安装在艇头的摄像头看起来像是骑自行车的人会绑在头盔上的那种装置（不过尺寸更大，如图所示，安装在艇身中部）。它的卫星接收器与SpaceX提供的星链终端非常相似。

乌克兰在众筹资料中称，每艘无人艇的成本仅为25万美元。相比之下，一枚反舰导弹可能要数百万美元。乌克兰筹到的钱会花得很值。这些无人艇可搭载200公斤高能炸药，撞向目标船体的吃水线。和导弹或空中无人机在船体更高处炸出一个洞的效果不同，这样的损伤会导致被击中船只的舷侧进水，可能会沉没。

这么看来，无人水面艇的发展似乎要重复商用无人机的发展轨迹。当初，无人机似乎在一夜之间就从发烧友用品店里的新奇玩意变成了致命的安全威胁，让各国政府措手不及。斯科特·克里诺（Scott Crino）的公司Red Six Solutions就如何防御无人机入侵向政府提供咨询，他说多年来他一直对官员说未来确实存在恶意使用海上无人设备的风险。“他们典型的反应就是点一下头。”他说。

要担心的不应只是海军。正如胡塞武装袭击所表明的那样，商业航运尤其面临风险。商船的安全措施通常是用远距离定向声波设备、强光灯和高压水炮等非致命手段阻遏攻击船只的船员，并加装铁丝网让他们无法强行登船。有些船只确实配备了武装警卫，但克里诺认为他们的小口径武器难以阻止破浪而来的增强版无人艇。

沿海基础设施也有危险。在有记录的胡塞武装袭击事件中，有六次是针对民用港口和石油码头。据美国国务院称，其中一次袭击对一艘新加坡油轮造成了“重大损害”。如果确认乌克兰对新罗西斯克的袭击是无人舰所为，

将充分证明任何滨海建筑都可能成为攻击目标，无论防备有多严密。

没有船员还给USV带来了其他优势。不需要船舱后，它们就可以潜行了。乌克兰的无人艇只露出水面几厘米，雷达和摄像机几乎无法侦测到，但与无人潜艇不同的是，它仍然能够与控制方保持无线电联系。（无线电波不能在水下传播。）这并不是说以后的型号就不能像德国U型潜艇那样完全潜入水下，比如可以在发动最后攻击时躲避侦测。哈马斯的无人潜艇可能就已经在按照类似的路数执行任务，它们在水面上时由GPS引导。

无需船员也意味着可以让无人艇更无所顾忌地执行任务。正如兰德公司（RAND Corporation）的高级工程师斯科特·萨维茨（Scott Savitz）所说，一个组织在计划进行神风敢死队式的海上攻击时就可以不用依赖“可能在最后一秒丧失勇气”的人了。在袭击塞瓦斯托波尔的视频中，无人艇在枪林弹雨中冲锋陷阵，无所畏惧。

那么该如何阻止USV的袭击呢？已经做出的第一反应是重新调整现有武器。几年前，法国军火公司泰雷兹（Thales）重新配置了其超音速岩燕导弹（Martlet），让它可以打击快速移动的小型水面舰艇。重新配置过的岩燕导弹将于2024年安装到英国的护卫舰上。美国海军最近也在对它所说的“水面作战模组”（Surface Warfare Mission Package）做收尾工作，该模组包括两门30毫米机关炮、两艘刚性充气船和一架直升机。美国海军称，该模组专门用于拦截快速移动的小型有人或无人船只。

除了这种应急调整之外，美国和英国都考虑过运用激光，两国都声称激光可以阻遏USV。但尚不清楚该技术是否已准备就绪。美国在亚丁湾的波特兰号（USS Portland）两栖运输舰上进行的测试针对的是固定目标。迄今为止披露出来的英国测试都是在陆地上展开的。

击落空中无人机的一种常用手段是用高强度电磁干扰阻断它们的无线电通信，或者使用一种叫“电子欺骗”的方法夺取对飞行器本身的控制。这可能也适用于拦截USV，不过克里诺说，加密链接和增强自主性等反制措施正变得越来越有效。

| 编队而来

另一个建议是用无人机来对付无人艇，尽管目前还只停留在假想阶段。按萨维茨的说法，可以在空中和海上部署一组无人机和无人艇充当“侦察兵和保镖”，监视可能来犯的USV，并在需要时对其发起攻击。6月，英国国防部与另一家军火公司BAE系统（BAE Systems）签订了一份紧急合同，准备在护卫舰上部署空中侦察无人机，“对抗水面无人艇”。（一名发言人指出，英国海军正在努力解决“多种环境中的新威胁”，但拒绝提供任何反无人艇工作的具体细节。）

通常情况下，当新的威胁从科技发展的阴暗面中浮现时，武装部队也会另辟蹊径寻找对策。一战时对付潜水艇和半潜水艇的捕潜网可能会被重新启用。萨维茨提到了美国的一项计划。该计划受在防御时会分泌粘液的盲鳗启发，目标是研发出一种可以黏住来犯USV的螺旋桨的粘液。

但是，即使拥有再多的火力、再多的粘液，防御本身都不可能是令人满意的应对措施。“等来犯武器进入点防御系统的范围内，试图阻止什么就已经很晚了。”美国海岸警卫队中校克雷格·艾伦（Craig Allen）说。因此，早期侦测至关重要。但克里诺指出，这在港口或繁忙的航道等拥挤的水域可能很难做到。

此外，这些措施假设的前提都是无人艇单独来犯。但它们更有可能是编队来袭。“说实话，阻止一个敌对目标来犯就已经非常困难了，”艾伦说，“每多增加一个目标都会让情况变得复杂得多。”

如果编队中的无人艇之间可以在无需人类干预的情况下协同作战，那就更麻烦了。这种情景可能并不遥远。这种集群作战能力在西方已经开发了一段时间，目前开始扩散。土耳其军火制造商Aselsan最近推出了信天翁-S，这是一种速度极快的USV，据说可以集群行动，共享有关打击目标和作战目的的信息。与此同时，位于武汉的海军工程大学兵器工程学院的工程师们正在构建“狩猎算法”，让USV群像追逐一群海豹的虎鲸群那样能够同时追踪多个目标。想用网来拦截？祝你好运了。■



Lives on the lines

Our model shows that China's covid death toll could be massive

It should act as a wake-up call for the government

MODELLING A COVID-19 epidemic anywhere is difficult. But it is especially hard in China, where the data are often unreliable. Take the official case numbers, which suggest the current outbreak is waning. It is clearly not. No one knows the true state of the epidemic in China.

But there is enough data available to produce an informed estimate of where things are heading. So we have built a model that calculates the trajectory of China's outbreak under different scenarios based on estimates of the rates at which people become infected, get sick, recover or die (known as a SEIR model). The results are shocking. If the virus is allowed to spread unencumbered, we predict that 1.5m Chinese people will die.

Our model builds upon work by Jun Cai of Fudan University and others. We account for how people of different age groups are affected by covid and how protected they are by Chinese vaccines. We looked at when the jabs were administered and assumed that they wane at the same rate as Western ones, though there is little evidence on this. We take China at its word when it comes to vaccination rates and intensive-care-unit (ICU) capacity because there are no alternative statistics.

Our model offers scenarios, not forecasts. The first, referenced above, is the most grim. About 96% of the population would catch the virus in the next three months. The demand for ICU beds would quickly exceed the supply. People over the age of 60 would account for 90% of the deaths. The economy would suffer, too. Nearly 2% of the working-age population would be sick and symptomatic at the height of such an outbreak.

At the other end of the spectrum is a scenario where 90% of the population is boosted and there are enough antiviral drugs to treat 90% of cases in people 60 or older. Had the government prepared in this way it could have lifted all restrictions and still kept the death toll under 72,000.

Our worst-case scenario is in line with estimates elsewhere. Wigram Capital Advisors, an investment firm, projects 1m covid deaths in China over the winter. It used a similar model with different assumptions. Before China lifted its restrictions, Airfinity, a data firm, estimated that between 1.3m and 2.1m people would die if China ended its “zero-covid” policy. They simply took the outbreak in Hong Kong earlier this year and scaled it to China’s population, with a range of 25% in either direction.

Even in the face of such dismal projections, new lockdowns seem unlikely. But people are taking steps, such as masking and staying at home, to “flatten the curve”. That might spread cases over time, easing the pressure on hospitals. If such steps reduced by a third the reproductive rate of the virus (known as R), the death toll would fall to 1.3m. If the government used that time to jab people and stock up on antiviral drugs, even more lives could be saved.

There is much we still don’t know. For example, the government claimed this month to have 138,000 ICU beds, more than double what it had recently been saying. That is an unbelievable increase. Nor is it clear exactly how much ICU access affects mortality rates (we assume that getting an ICU bed doubles the chance of survival for those who need one). Then there are covid drugs, which could prevent hundreds of thousands of deaths. Whether or not China has enough is unknown. Lastly, the sub-variant hitting China is still being studied.

All these factors could throw off our estimates, which will anyway be hard to judge. China is likely to hide the true toll of covid. So many preventable

deaths do not chime with the Communist Party's self-styled image of infallibility. ■



命悬一线

我们的模型显示，中国的新冠死亡人数可能会相当庞大

这应该让中国政府警醒

在任何地方建模预测新冠疫情都是困难的。但在中国尤其困难，因为数据往往不可靠，比如官方公布的病例数字表明目前疫情正在消退，实际显然并非如此。没有人知道中国疫情的真实现状。

但有足够的数据来对疫情的发展走向做出理据充分的估计。因此，本刊基于对感染、病发、康复或死亡的速度的估计来建模（名为SEIR模型），测算不同情境下中国疫情的发展轨迹。结果令人震惊。假如任由新冠病毒传播肆虐，我们预计将有150万中国人死亡。

我们的模型以复旦大学的蔡俊等人的研究为基础，考虑了不同年龄段人群对新冠病毒的不同反应以及中国的疫苗对他们的保护效力。我们研究了人们接种疫苗的时间，并假设中国疫苗的保护力减弱的速度与西方疫苗相同，尽管相关证据不多。至于疫苗接种率和ICU床位数量，我们采用了中国官方数字，因为没有其他统计数据可用。

本模型是假设各种情境，并非要做预报。上文所说的第一种情境形势最为严峻。约96%的人口将在未来三个月内感染新冠病毒。ICU床位将很快供不应求。60岁以上人群将占死亡人数的90%。经济也会受影响。在这种情境下的疫情高峰期，近2%的劳动年龄人口会生病并伴随症状。

还有处于光谱另一端的一种情境：90%的人口接种了加强疫苗，有足够的抗病毒药物给90%的60岁或以上的病例提供治疗。假如政府做了这样的准备工作，即使取消了所有限制措施，新冠死亡人数仍可控制在72,000人以下。

本刊模拟的最坏情境与其他机构的估计一致。投资公司威格拉姆资本顾问（Wigram Capital Advisors）预测中国今冬将有100万人死于新冠。它使用

了类似的模型，只是假设条件不同。在中国取消限制措施之前，数据分析公司Airfinity曾估计中国在取消“清零”政策后新冠死亡人数将达130万至210万。它的预测只是把今年初香港疫情的死亡人数按人口等比例放大到全中国，上下偏差25%。

即使面对如此悲观的预测，政府似乎也不太可能再实施新的封控措施。但人们正采取办法“压平曲线”，比如戴上口罩或者足不出户。这可能会在一段时间内分散病例，缓解医院的压力。如果这些做法能把病毒的传染率（以下简称R值）降低三分之一，死亡人数将下降到130万。如果政府利用这段时间加强接种并储备抗病毒药物，甚至可以挽回更多性命。

还有很多情况我们仍不了解。例如，本月政府声称全国ICU床位总数达13.81万张，是先前公布数字的两倍还多，增速令人难以置信。同样不清晰的是ICU床位对死亡率究竟有多大影响（我们假设获得ICU床位能使急需病人的生存机会翻倍）。然后是可能挽回数十万条性命的新冠药物，中国是否有足够的储备也不得而知。最后，对中国这波疫情中的病毒亚变体的研究尚在进行中。

这些因素都可能推翻我们本来就难以评判的估计。中国可能会隐瞒真实的新冠死亡数字。若出现这么多本可避免的死亡，和中共自诩的绝对正确的形象太不一致了。■



The new rules in financial markets

Investing in an era of higher interest rates and scarcer capital

Prepare for impatient investors and pain in private markets—but also higher returns

WELCOME TO THE end of cheap money. Share prices have been through worse, but only rarely have things been as bloody in so many asset markets at once. Investors find themselves in a new world and they need a new set of rules.

The pain has been intense. The S&P 500 index of leading American shares was down by almost a quarter at its lowest point this year, erasing more than \$10trn in market value. Government bonds, usually a shelter from stocks, have been blasted: Treasuries are heading for their worst year since 1949. As of mid-October, a portfolio split 60/40 between American equities and Treasuries had fallen more than in any year since 1937. Meanwhile house prices are falling everywhere from Vancouver to Sydney. Bitcoin has crashed. Gold did not glitter. Commodities alone had a good year—and that was in part because of war.

The shock was all the worse because investors had become used to low inflation. After the global financial crisis of 2007-09, central banks cut interest rates in an attempt to revive the economy. As rates fell and stayed down, asset prices surged and a “bull market in everything” took hold. From its low in 2009 to its peak in 2021, the S&P 500 rose seven-fold. Venture capitalists wrote ever bigger cheques for all manner of startups. Private markets around the world—private equity, as well as property, infrastructure and private lending—quadrupled in size, to more than \$10trn.

This year’s dramatic reversal was triggered by rising interest rates. The Federal Reserve has tightened more quickly than at any time since the

1980s, and other central banks have been dragged along behind. Look deeper, though, and the underlying cause is resurgent inflation. Across the rich world, consumer prices are rising at their fastest annual pace in four decades.

This era of dearer money demands a shift in how investors approach the markets. As reality sinks in, they are scrambling to adjust to the new rules. They should focus on three.

One is that expected returns will be higher. As interest rates fell in the bull years of the 2010s, future income was transformed into capital gains. The downside of higher prices was lower expected returns. By symmetry, this year's capital losses have a silver lining: future real returns have gone up. This is easiest to grasp by considering Treasury Inflation-Protected Securities (TIPS), which have yields that are a proxy for real risk-free returns. Last year the yield on a ten-year TIPS was minus 1% or lower. Now it is around 1.2%. Investors who held those bonds over that period have suffered a hefty capital loss. But higher TIPS yields mean higher real returns in future.

Obviously, no law dictates that asset prices which have fallen a lot cannot fall further. Markets are jumpy as they await signals from the Fed about the pace of interest-rate rises. A recession in America would crush profits and spur a flight from risk, driving down share prices.

However, as Warren Buffett once argued, prospective investors should rejoice when stock prices fall; only those who plan to sell soon should be happy with high prices. Nervous or illiquid investors will sell at the bottom, but they will regret it. Those with the skill, nerve and capital will take advantage of the higher expected returns and thrive.

The second rule is that investors' horizons have shortened. Higher interest

rates are making them impatient, as the present value of future income streams falls. This has dealt a blow to the share prices of technology companies, which promise bountiful profits in the distant future, even as their business models are starting to show their age. The share prices of the five biggest tech firms included in the S&P 500, which make up a fifth of its market capitalisation, have fallen by 40% this year.

As the scales tilt from newish firms and towards old ones, seemingly burnt-out business models, such as European banking, will find a new lease of life. Not every fledgling firm will be starved of funding, but the cheques will be smaller and the cheque-books brandished less often. Investors will have less patience for firms with heavy upfront costs and distant profits. Tesla has been a big success, but legacy carmakers suddenly have an edge. They can draw on cashflows from past investments, whereas even deserving would-be disrupters will find it harder to raise money.

The third rule is that investment strategies will change. One popular approach since the 2010s has blended passive index investing in public markets with active investing in private ones. This saw vast amounts of money flow into private credit, which was worth over \$1trn at its peak. Roughly a fifth of the portfolios of American public pension funds were in private equity and property. Private-equity deals made up about 20% of all mergers and acquisitions by value.

One side of the strategy looks vulnerable—but not the part that many industry insiders are now inclined to reject. To its critics, index investing is a bust since tech companies loom large in indices, which are weighted by market value. In fact, index investing will not disappear. It is a cheap way for large numbers of investors to achieve the average market return.

| *Where to worry*

It is those high-fee private investments that deserve scrutiny. The

performance of private assets has been much vaunted. By one estimate private-equity funds globally marked up the value of the firms they own by 3.2%, even as the S&P 500 shed 22.3%.

This is largely a mirage. Because the assets of private funds are not traded, managers have wide discretion over the value they place on them. They are notoriously slow in marking these down, perhaps because their fees are based on the value of the portfolio. However, the falling value of listed firms will eventually be felt even in privately owned businesses. In time, investors in private assets who thought they had avoided the crash in public markets will face losses, too.

A cohort of investors must get to grips with the new regime of higher interest rates and scarcer capital. That will not be easy, but they should take the long view. The new normal has history on its side. It was the era of cheap money that was weird. ■



【首文】金融市场的新规则

高利率和资本稀缺时代的投资之道

准备面对没耐心的投资者和私人市场中的痛苦吧——但也会有更高的回报

欢迎见证廉价资金的终结。股价也曾经历过更糟糕的情况，但这么多资产市场同时上演如此惨烈的景象还是十分少见。投资者发觉自己已身处一个新世界，需要一套新的规则。

痛感很强烈。由美国龙头股构成的标普500指数在今年的最低点跌幅达到近四分之一，抹去了超过10万亿美元的市值。政府债券通常是躲避股票波动的避风港，现在也遭重创：美国国债正走向自1949年以来最差的一年。截至10月中旬，由美国股票和美国国债构成的60/40投资组合的跌幅超过1937年以来的任何一个年份。与此同时，从温哥华到悉尼，各地房价都在下跌。比特币崩盘。黄金失去了光彩。只有大宗商品享受了一个好年景——一定程度上还是因为战争。

由于投资者已经习惯了低通胀，这种冲击愈显严重。2007至2009年的全球金融危机之后，各国央行纷纷降息，试图重振经济。随着利率下降并保持在低位，资产价格飙升，“一切皆牛市”的看法逐渐深入人心。从2009年的低点到2021年的高点，标普500指数上涨了七倍。风险资本家为各种各样的创业公司开出了越来越大的支票。世界各地的私人市场——私募股权，以及房地产、基础设施和私人贷款——规模翻了两番，突破10万亿美元。

今年的戏剧性逆转是由利率上升触发的。自20世纪80年代以来，美联储还从未以如此之快的速度收紧政策，其他央行也只得在其后踉跄跟随。然而更深入地探究会发现，根本原因是通胀抬头。在整个富裕世界，消费价格正以四十年来最快的速度上涨。

在这个资金变得昂贵的时代，投资者需要改变对待市场的方式。随着他们逐步认清现实，他们也在努力适应新的规则。他们应该关注三点。

一是预期收益率会升高。随着利率在2010年代那些年的牛市中下降，未来收入转化为资本利得。价格上涨的不利影响就是预期收益率下降。相应地，今年的资本损失也有好的一面：未来的实际收益率已经上升。要理解这一点，看通货膨胀保值债券（TIPS）最简单不过了。TIPS的收益率是个衡量真实无风险回报率的指标。去年，10年期TIPS的收益率为负1%或更低，现在是1.2%左右。在此期间持有这些债券的投资者遭受了巨大的资本损失。但更高的TIPS收益率意味着未来的实际回报会更高。

显然，没有什么铁律规定已经大幅下跌的资产价格不能继续下跌。市场在等待美联储发出关于加息步伐的信号时有如惊弓之鸟。美国的经济衰退会碾压利润，刺激投资者紧急避险，从而压低股价。

然而，正如沃伦·巴菲特曾经主张的那样，当股价下跌时，打算投资的人应该欢欣鼓舞才是；只有那些打算尽快卖出的人才会因为价格高涨而开心。焦灼不安或缺乏流动性的投资者会在谷底卖出，但他们会后悔。那些兼具技能、胆量和资本的人会抓住获得更高预期回报的机会而腾飞。

第二条规则是投资者的投资期限变短了。利率上升使得未来收入流的现值下降，正让他们失去耐心。这已经冲击了科技公司的股价，这些公司承诺在遥远的未来会有丰厚的利润，然而它们的商业模式却开始显现老态。标普500收录的五大科技公司（占该指数市值的五分之一）的股价今年下跌了40%。

随着天平从新兴公司向老牌公司倾斜，那些貌似死气沉沉的商业模式，比如欧洲的银行业，将会获得新生。并不是每一家新起步的公司都会无处融资，只不过支票金额不会那么大，支票也不会开得那么勤了。投资者将对前期成本高、盈利遥遥无期的公司不再那么有耐心。特斯拉取得了巨大成功，但传统汽车制造商突然间拥有了优势。它们有过去的投资产生的现金流可利用，而即使那些值得一投的潜在颠覆者也会更难筹到资金。

第三条规则是投资策略会变。自2010年代以来，一种流行的方法是将公开市场的被动指数投资与私人市场的主动投资相结合。其结果是大量资金流

入私人信贷，高峰时超过一万亿美元。美国公共养老基金的投资组合中大约有五分之一是私募股权和房地产。按价值计算，私募股权交易约占所有并购交易的20%。

这个策略有一个方面看起来很脆弱——但并不是许多业内人士现在往往会排斥的那个部分。批评该策略的人认为指数投资这种方法不怎么样，因为各种指数多以科技公司为主，又是按市值加权。事实上，指数投资不会消失。对于大批投资者来说，这是一种获得平均市场回报的低成本方式。

| 该担心哪里

值得审视的是那些高收费的私人投资。私人资产的表现被过分夸大了。一项估计显示，全球私募股权基金将所持有公司的价值标高了3.2%，尽管同期标普500下挫22.3%。

这大体上是个幻象。因为私募基金的资产并未交易，所以基金经理在给它们估值时有很大的自由裁量权。他们调低资产价值的动作出了名地慢，也许是因为他们的收费是基于投资组合的价值。然而，就算是私人企业最终也会受上市公司价值下降波及。随着时间的推移，那些觉得自己躲过了公开市场崩盘的私人资产投资者也将面临损失。

一些投资者必须理解和应对这个利率更高、资本更稀缺的新体系。这并非易事，但他们应该从长计议。这个新常态有史可依，反倒是廉价资金的时代才古怪。■



The chips hit the fan

A global electronics slump is driving East Asia to the wall

China's zero-covid slowdown is only one factor troubling the region's trade champions

ON DECEMBER 7TH China announced it was relaxing yet more of its covid-19 restrictions. The news was well received by the once roaring economies of East Asia. In recent days many have reported terrible trade data that suggest the domestic effects of China's zero-covid policies have ricocheted across the region. A reopening, however tentative, can only help. But the reasons behind the tigers' angst extend well beyond woes faced by their big neighbour. As the world spends less on expensive gadgets, the world's busiest manufacturing hub is being driven to the wall.

China is certainly a big factor in the sharp deceleration across the region. Asia's largest economy is reeling from many months of disruptive pandemic-control measures and a homegrown property crisis. Data released on December 7th showed a 9% year-on-year fall in Chinese exports in November, a far steeper decline than expected by analysts.

As Asia's growth engine sputters, so does trade between countries in the region. Exports from trade-intensive South Korea, which slid by 14% year on year overall in November, were particularly hampered by dwindling sales to China, which shrank by 26%—the biggest 12-month decline since 2009. Taiwan's sales to the mainland and Hong Kong slumped by 21% over the period. There may be more bad news to come. Dwindling intra-Asian trade, which is largely made up of intermediate goods, probably signals a deeper drop in future sales of finished products.

The China drag may start to ebb at some point next year—but slowly at best. The recovery of the world's second-biggest economy could take many months and large outbreaks of covid-19, as rules are loosened, could cause

short-term disruptions.

Meanwhile a second, lesser known factor is likely to keep hindering East Asia's trade giants: the storm facing the global electronics industry.

Worldwide sales of PCs were down by 20% in the third quarter of the year compared with the same period in 2021. That is holding back Chinese exports of data-processing machines and their parts—the category which includes personal computers. These fell by 28% year on year in November.

The shift is also bad news for South Korea, the dominant producer of the memory chips found in computers worldwide. Its exports of goods to Japan dwindled by 18% year on year in November. It even affects further-flung hubs like Singapore, whose exports of electronics fell by 9.3% in October. Oxford Economics, a consultancy, expects a further slump in goods exports from the region next year, of around 4%.

Rapid increases in interest rates in America, with other central banks forced to follow suit, are fuelling the slowdown by crimping households' and companies' demand for consumer goods. That effect is visible in orders of machine tools from Japan, a bellwether for industrial activity globally. They fell by 5.5% year on year in October. Electrical and precision machinery orders were most affected, sinking by 27% over the period.

The squeeze on Asian industry is in stark contrast to the years after the financial crisis, when low interest rates and a booming Chinese economy were a boon to the region's industrial networks. Natixis, an investment bank, expects semiconductor demand to remain subdued until at least next summer; rate-setters at the Federal Reserve, and China's public-health bosses, may remain cautious for even longer. East Asia's famished tigers could face many more lean months. ■



芯片撞南墙

全球电子产品市场低迷让东亚陷入困境

中国因清零政策而经济低迷只是困扰该区域各贸易大户的因素之一

十二月七日，中国宣布进一步放松新冠疫情防控。这个消息受到了那些经济一度高歌猛进的东亚国家的欢迎。近日，它们中的许多发布了糟糕的贸易数据，表明中国清零政策的国内影响已经波及整个地区。即便是试探性的重新开放也会有所帮助。但让东亚小虎们焦虑的远远不止它们的大块头邻居面对的麻烦。随着世界各国在昂贵的电子小设备上支出减少，全球最繁忙的制造业中心正被逼入窘境。

中国无疑是整个区域经济急剧减速的一个重大因素。持续多月的干扰性疫情防控措施和本土房地产危机让这个亚洲最大的经济体步履蹒跚。12月7日公布的数据显示，11月中国出口同比下降9%，降幅远超分析师预期。

亚洲经济增长的引擎熄火，区域内各国之间的贸易也随之下降。11月，贸易密集型的韩国出口同比下降了14%，其中对华销售下跌的拖累尤其明显——这部分萎缩了26%，是自2009年以来最大的同比降幅。同一时期，台湾对中国大陆和中国香港的出口下降了21%。接下来可能还会有更多的坏消息。亚洲内部贸易主要由中间产品构成，内部贸易日益萎缩可能预示着未来制成品销售会以更大的幅度下滑。

中国的影响可能会在明年某个时候开始减弱，但最多也只是缓慢消退。世界第二大经济体的复苏可能需要很多个月，随着防疫政策松动，新冠疫情的大规模爆发可能会造成短期混乱。

与此同时，另一个不太为人所知的因素很可能会继续阻碍东亚的各个贸易巨头：全球电子行业面临的风暴。与2021年同期相比，今年第三季度全球个人电脑销量下降了20%。这抑制了中国数据处理设备及零部件的出口——个人电脑也在此列。这部分出口11月同比下降28%。

这种变化对韩国来说也是坏消息，它是全球各地的计算机中用到的存储芯片的主要生产国。11月，韩国对日本的商品出口同比下降了18%。甚至像新加坡这样更偏远的枢纽也受到了影响，其10月的电子产品出口下降了9.3%。咨询机构牛津经济研究院（Oxford Economics）预计，明年整个区域的商品出口还将下滑4%左右。

美国迅速加息，加之其他央行被迫跟进，抑制了家庭和企业对消费品的需求，加剧了出口放缓。这种影响在全球工业活动的风向标——日本机床——的订单上可见一斑。这类订单10月同比下降了5.5%。电气和精密机械订单受影响最大，在此期间下降了27%。

亚洲工业受到的挤压与金融危机后的那几年形成了鲜明对比，当时低利率和蓬勃发展的中国经济让该区域的工业网络获益良多。投行法国外贸银行（Natixis）预计半导体需求至少在明年夏天之前都将继续低迷；美联储的利率政策官员和中国的公共卫生官员们保持谨慎的时间或许还会更久。东亚饥肠辘辘的小虎们可能还要饿上好些个月。■



The monetary marathon

Inflation is falling—but not enough

Central bankers have a long way to go before they hit their targets

BEFORE THE pandemic the idea of an annual rate of inflation of 10% in the euro zone would have seemed like a horror story. In November it was good news. Inflation had been 10.6% the month before. A similar surprise came from America. As inflation falls, so does the expected pace of interest-rate increases. On December 14th and 15th the Federal Reserve, European Central Bank and Bank of England will each probably raise rates by half a percentage point—a deceleration from the three-quarter-point rises that have recently prevailed.

Globally, inflation has begun to decline primarily because energy prices have eased since the summer and because supply chains, long gummed up by the pandemic, are operating more smoothly. Yet inflation remains a very long way from central banks' 2% targets. There are three reasons to think rate-setters will struggle to hit their goals soon.

The first is a continued scarcity of workers. While the news on prices has been good, the latest wage data are worrying. In America average hourly earnings had shown encouraging signs of softening since August. But updated figures released on December 2nd upended the picture, showing annualised growth of 5.1% over the past three months, roughly in line with other surveys. Since the data came out stockmarkets in America have fallen, in expectation of prolonged interest-rate rises. In Britain wages are growing at a similar rate; a wave of strikes may prompt still bigger increases. The euro zone's labour markets, though not as sizzling, are hot enough to make policymakers worry that energy inflation could affect the rest of the economy as workers bargain for higher wages to offset rising living costs.

The second problem is fiscal policy. It would help central banks to cool labour markets if governments shrank their budget deficits. Yet America's recent Inflation Reduction Act makes only a minimal dent in government borrowing, and the Biden administration is trying to forgive swathes of student debt. Europe is splurging on energy subsidies despite warnings from the IMF and others that it is unwise to stimulate economies which lack spare productive capacity—a mistake America made in 2021, when President Joe Biden's "American Rescue Plan" overheated the economy. If the EU retains its measures throughout 2023 the cost, net of taxes raised to fund the handouts, will reach nearly 2% of GDP (see chart). In aggregate Britain's much advertised belt-tightening will not begin until 2025, thanks to its costly energy-price cap.

Nearly two-thirds of the EU's energy spending is on controlling prices for everyone, which is expensive and discourages energy saving. Only a fifth comes in the form of targeted redistribution to the needy, the approach recommended by the likes of the IMF. Even Germany, which has capped prices only up to 80% of a household's previous usage, is still borrowing to fund the scheme, meaning that it will deliver an economic stimulus.

The final danger is that energy inflation returns in 2023. This year Europe's economies have benefited from weak competition for scarce supplies of global liquefied natural gas (LNG), in part because China's economy has been hampered by its zero-covid policy. But China has begun to loosen its pandemic controls. If its economy reopens and rebounds, LNG prices could surge in 2023. Central bankers' battle with inflation has reached an inflection point. But it will not be won for a long time. ■



货币马拉松

通胀回落，但不够多

央行距离达到通胀目标还很远

在疫情前的世界里，欧元区年通胀率达到10%仿佛还是恐怖片的情节。今年11月，这却成了好消息。前一个月的通胀率为10.6%。美国也有类似的惊喜发生。随着通胀回落，预期加息的步伐也将放缓。在12月14日和15日，美联储、欧洲央行和英国央行可能会各自加息0.5个百分点——相对于近期常见的加息0.75个百分点速度放缓。

全球范围内通胀开始下降，主要原因是能源价格自今年夏季以来已经回落，同时长期受疫情困扰的供应链也已经运行得更加顺畅。然而，通胀距离央行2%的目标仍然相去甚远。利率制定者恐怕难以很快实现他们的通胀目标，这有三方面的原因。

首先是劳动力持续短缺。虽然物价方面有了好消息，但最新的工资数据却令人担忧。在美国，自8月以来平均时薪显示出下行迹象，令人鼓舞。但12月2日发布的最新数据却颠覆了这幅图景，显示过去三个月的年化薪资增幅达5.1%，与其他调查结果大致一致。数据公布之后，由于预期加息仍将继续，美国股市应声下跌。在英国，工资也以近似的速度增长；而在罢工潮之下，涨幅可能还会更高。欧元区的劳动力市场没那么火爆，但也热度不低，随着工人争取更高的工资以抵消不断上涨的生活成本，政策制定者担心能源通胀可能波及其他经济领域。

第二个问题是财政政策。如果政府缩减预算赤字，将有助于央行给劳动力市场降温。然而，美国最近的《通胀削减法案》（Inflation Reduction Act）在减少政府债务上的作用微乎其微，而拜登政府还在试图免除大量学生贷款。欧洲仍在大手笔提供能源补贴，尽管国际货币基金组织（IMF）等机构警告称，在缺乏闲置产能的情况下刺激经济是不明智的——美国在2021年就曾犯过类似的错误，当时拜登的“美国救援计划”（American Rescue Plan）导致了经济过热。如果欧盟在整个2023年都

维持能源补贴，那么在不计入为支持补贴而征收的税款的情况下，其成本将接近GDP的2%（见图表）。总体而言，由于英国在国内实施的能源价格上限政策成本高昂，它大力宣扬的紧缩政策要到2025年后才会真正启动。

欧盟近三分之二的能源支出用于为全民控制价格，此举既昂贵又不利于节能。只有五分之一的支出采取了IMF等机构建议的方法，向贫困人口定向再分配。即使德国仅为家庭此前耗能水平的最多80%限价，仍然需要举债为该计划提供资金，这实际上就是一种经济刺激。

最后一个危险是，能源通胀将在2023年卷土重来。今年，对全球液化天然气（LNG）稀缺供应的争夺并不激烈，欧洲经济体因而从中受益，部分原因是中国经济受到清零政策的拖累。但中国已经开始放松疫情管控。如果中国经济重新开放并反弹，LNG价格可能会在2023年飙升。央行官员与通胀的斗争已经达到拐点。但要赢下此役仍需较长时日。 ■



Generating buzz

Artificial intelligence is permeating business at last

The age of “boring AI” will be anything but

THE MACHINES are coming for your crops—at least in a few fields in America. This autumn John Deere, a tractor-maker, shipped its first fleet of fully self-driving machines to farmers. The tilling tractors are equipped with six cameras which use artificial intelligence (AI) to recognise obstacles and manoeuvre out of the way. Julian Sanchez, who runs the firm’s emerging-technology unit, estimates that about half the vehicles John Deere sells have some AI capabilities. That includes systems which use onboard cameras to detect weeds among the crops and then spray pesticides, and combine harvesters which automatically alter their own setting to waste as little grain as possible. Mr Sanchez says that for a medium-sized farm, the additional cost of buying an AI-enhanced tractor is recouped in two to three years.

For decades starry-eyed technologists have claimed that AI will upend the business world, creating enormous benefits for firms and customers. John Deere is not the only proof that this is happening at last. A survey by McKinsey, a consultancy, found that this year 50% of firms across the world had tried to use AI in some way, up from 20% in 2017. Powerful new “foundation” models are fast moving from the lab to the real world. ChatGPT, a new AI tool that has recently been released for public testing, is making waves for its ability to craft clever jokes and explain scientific concepts. But excitement is also palpable among corporate users of AI, its developers and those developers’ venture-capital backers. Many of them attended a week-long jamboree hosted in Las Vegas by Amazon Web Services, the tech giant’s cloud-computing arm. The event, which ended on December 2nd, was packed with talks and workshops on AI. Among the

busiest booths in the exhibition hall were those of AI firms such as Dataiku and Blackbook.ai.

The buzzing AI scene is an exception to the downbeat mood across techdom, which is in the midst of a deep slump. In 2022 venture capitalists have ploughed \$67bn into firms that claim to specialise in AI, according to PitchBook, a data firm. The share of VC deals globally involving such startups has ticked up since mid-2021, to 15% so far this quarter (see chart 1). Between January and October, 28 new AI unicorns (private startups valued at \$1bn or more) have been minted. Microsoft is said to be in talks to increase its stake in OpenAI, a builder of foundation models and ChatGPT's provider. Alphabet, Google's parent company, is reportedly planning to invest \$200m in Cohere, a rival to OpenAI. At least 22 AI startups have been launched by alumni of OpenAI and Deepmind, one of Alphabet's AI labs, according to a report by Ian Hogarth and Nathan Benaich, two British entrepreneurs.

The exuberance is not confined to Silicon Valley. Big firms of all sorts are desperate for AI talent. In the past 12 months large American firms in the S&P 500 index have acquired 52 AI startups, compared with 24 purchases in 2017, according to PitchBook. PredictLeads, another data provider, notes that the same group of firms posted around 7,000 job ads a month for AI and machine-learning experts in the three months to November, about ten times more than in the first quarter of 2020 (see chart 2). Derek Zanutto of CapitalG, one of Alphabet's VC divisions, notes that large firms spent years collecting data and investing in related technology. Now they want to use this "data stack" to their advantage. AI offers ways to do so.

Unsurprisingly, the first industry to embrace AI was the technology sector. From the 2000s onwards, machine-learning techniques helped Google supercharge its online-advertising business. Now it uses AI to improve search results, finish your sentences in Gmail and work out ways to cut

energy use in its data centres, among other things. Amazon's AI manages its supply chains, instructs warehouse robots and predicts which job applicants will be good workers; Apple's powers its Siri digital assistant; Meta's serves up attention-grabbing social-media posts; and Microsoft's does everything from stripping out background noise in Teams, its videoconferencing service, to letting users create first drafts of PowerPoint presentations.

Big tech quickly spied an opportunity to sell some of those same AI capabilities to clients. Amazon, Google and Microsoft all now provide such tools to customers of their cloud-computing divisions. Revenues from Microsoft's machine-learning cloud service have doubled in each of the past four quarters, year on year. Upstart providers have proliferated, from Avidbots, a Canadian developer of robots that sweep warehouse floors, to Gong, whose app helps sales teams follow up a lead. Greater use of cloud computing, which brings down the cost of using AI, enabled the technology to spread to other sectors, from industry to insurance. You may not see it, but these days AI is everywhere.

| *Dulling the cutting edge*

In 2006 Nick Bostrom of Oxford University observed that "once something becomes useful enough and common enough it's not labelled AI any more". Ali Ghodsi, boss of Databricks, a company that helps customers manage data for AI applications, sees an explosion of such "boring AI". He argues that over the next few years AI will be applied to ever more jobs and company functions. Lots of small improvements in AI's predictive power can add up to better products and big savings.

This is especially true in less flashy areas where firms are already using some kind of analytics, such as managing supply chains. When in September Hurricane Ian forced Walmart to shut a large distribution hub, halting the flow of goods to supermarkets in Florida, the retailer used a new

AI-powered simulation of its supply chain to reroute deliveries from other hubs and predict how demand for goods would change after the storm. Thanks to AI this took hours rather than days, says Srini Venkatesan of Walmart's tech division.

The coming wave of foundation models is likely to turn a lot more AI boring. These algorithms hold two big promises for business. The first is that foundation models are capable of generating new content. Stability AI and Midjourney, two startups, build generative models which create new images for a given prompt. Request a dog on a unicycle in the style of Picasso—or, less frivolously, a logo for a new startup—and the algorithm conjures it up in a minute or so. Other startups build applications on top of other companies' foundation models. Jasper and Copy.AI both pay OpenAI for access to GPT3, which enables their applications to convert simple prompts into marketing copy.

The second advantage is that, once trained, foundation AIs are good at performing a variety of tasks rather than a single specialised one. Take GPT3, a natural-language model developed by OpenAI, which forms the basis for ChatGPT. It was first trained on large chunks of the internet, then fine-tuned by different startups to do various things, such as writing marketing copy, filling in tax forms and building websites from a series of text prompts. Rough estimates by Beena Ammanath, who heads the AI practice of Deloitte, a consultancy, suggest that foundation models' versatility could cut the costs of an AI project by 20-30%.

One early successful use of generative AI is, again predictably, the province of tech: computer programming. Several firms are offering a virtual assistant trained on a large deposit of code that churns out new lines when prompted. One example is Copilot on GitHub, a Microsoft-owned platform which hosts open-source programs. Programmers using Copilot outsource nearly 40% of code-writing to it. This speeds up programming by 50%, the

firm claims. In June Amazon launched CodeWhisperer, its version of the tool. Alphabet is reportedly using something similar, codenamed PitchFork, internally.

| *Artificial colouring*

In May Satya Nadella, Microsoft's boss, declared, "We envision a world where everyone, no matter their profession, can have a Copilot for everything they do." In October Microsoft launched a tool which automatically wrangles data for users following prompts. Amazon and Google may try to produce something like it. Several startups are already doing so. Adept, a Californian company run by former employees from Deepmind, OpenAI and Google, is working on "a Copilot for knowledge workers", says Kelsey Szot, a co-founder of the firm. In September the company released a video of its first foundation model, which uses prompts to crunch numbers in a spreadsheet and to perform searches on property websites. It plans to develop similar tools for business analysts, salespeople and other corporate jobs.

Corporate users are experimenting with generative AI in other creative ways. Mr Sanchez of John Deere says that his firm is looking into AI-generated "synthetic" data, which would help train other AI models. In December 2021 Nike, a sportswear giant, bought a firm that uses such algorithms to create new sneaker designs. Alexa, Amazon's virtual assistant, can now invent stories to tell children. Nestlé, a giant Swiss foodmaking firm, is using images created by DALLE-2, another OpenAI model, to help sell its yogurts. Some financial firms are employing AI to whip up a first draft of their quarterly reports.

Users of foundation models can also tap an emerging industry of professional prompters, who craft directions so as to optimise the models' output. PromptBase is a marketplace where users can buy and sell prompts that produce particularly spiffy results from the large image-based

generative models, such as DALLÉ-2 and Midjourney. The site also lets you hire expert “prompt engineers”, some of whom charge a \$50-200 per prompt. “It’s all about writing prompts these days,” says Thomas Dohmke, boss of GitHub.

As with all powerful new tools, businesses must tread carefully as they deploy more AI. Having been trained on the internet, many foundation models reflect humanity, warts and all. One study by academics at Stanford University found that when GPT3 was asked to complete a sentence starting “Two Muslims walked into a...”, the result was likely to invoke violence far more often than when the phrase referred to Christians or Buddhists. Meta pulled down Galactica, its foundation model for science, after claims that it generated real-sounding but fake research. Carl Bergstrom, a biologist at the University of Washington in Seattle, called it a “random bullshit generator”. (Meta says that the model remains available for researchers who want to learn about the work.)

Other problems are specific to the world of business. Because foundation models tend to be black boxes, offering no explanation of how they arrived at their results, they can create legal liabilities when things go amiss. And they will not do much for those firms that lack a clear idea of what they want AI to do, or which fail to teach employees how to use it. This may help explain why merely a quarter of respondents to the McKinsey’s survey said that AI had benefited the bottom line (defined as a 5% boost to earnings). The share of firms seeing a large benefit (an increase in earnings of over 20%) is in the low single digits—and many of those are tech firms, says Michael Chui, who worked on the study.

Still, those proportions are bound to keep rising as more AI becomes ever more dull. Rarely has the boring elicited this much excitement. ■



渐成声势

人工智能终于开始渗透进商业领域

“无聊AI”的时代绝不无聊【深度】

机器可以代人种地了——别不信，至少在美国的一些田地里就做到了。今年秋天，拖拉机制造商约翰迪尔（John Deere）向农民交付了第一批全自动驾驶拖拉机。这种耕作拖拉机配备六个摄像头，可以利用人工智能（AI）识别并灵活地避开障碍物。该公司新兴技术部门负责人朱利安·桑切斯（Julian Sanchez）估计，约翰迪尔销售的农业机械中约有一半具备某些AI功能。其中包括使用车载摄像头检测作物中的杂草然后喷洒除草剂的系统，以及可以自动改变设置以尽量减少谷物浪费的联合收割机。桑切斯表示，对于一个中型农场来说，两三年就能收回购买一台AI增强型拖拉机时多花的钱。

几十年来，满怀憧憬的技术专家声称AI将颠覆商业世界，为企业和客户带来巨大福祉。他们的预言现在终于在变成现实，而约翰迪尔并不是唯一的证明者。咨询公司麦肯锡的一项调查发现，今年全球50%的公司或多或少都在尝试使用AI，而2017年这一比例为20%。强大的新型“基础”模型正迅速从实验室走向现实世界。新推出的AI工具ChatGPT不久前启动了公开测试，它因为能编出诙谐的笑话以及解释科学概念而大出风头。但为之欢欣鼓舞的显然还有AI的企业用户、开发者及其风险资本投资人。他们中的许多人参加了科技巨头亚马逊的云计算部门AWS在拉斯维加斯举办的盛会。这次大会为期一周，于12月2日闭幕，其中排满了有关AI的演讲和研讨会。展厅中最繁忙的是Dataiku和Blackbook.ai等AI公司的展位。

在陷入深度低迷、被沮丧情绪笼罩的科技行业，热闹的AI圈子是个例外。数据公司PitchBook称，2022年，风险投资家已经向声称专攻AI的公司投入了670亿美元。自2021年年中以来，全球涉及此类创业公司的风投交易份额持续上升，本季度截至目前已上升至15%（见图表1）。今年1月至10月新诞生了28家AI独角兽公司（估值10亿美元或以上的私营创业公司）。据说微软正在与基础模型构建者、ChatGPT供应商OpenAI商谈增持股份事

宜。据报道，谷歌的母公司Alphabet正计划向OpenAI的竞争对手Cohere投资两亿美元。英国企业家伊恩·霍加斯（Ian Hogarth）和内森·贝纳希（Nathan Benaich）的一份报告显示，OpenAI和Deepmind（Alphabet的人工智能实验室之一）的前员工已经创办了至少22家AI创业公司。

这种繁荣景象并不局限于硅谷。各路大企业都对AI人才求贤若渴。根据PitchBook的数据，在过去12个月里，标普500指数中的大型美国公司收购了52家AI创业公司，而2017年为24家。另一家数据供应商PredictLeads指出，今年9月至11月，这批公司每月发布的AI和机器学习专业人才的招聘广告数量在7000则左右，差不多是2020年第一季度时的10倍（见图表2）。Alphabet的一个风投部门CapitalG的德里克·扎努托（Derek Zanutto）指出，大公司花了好几年时间收集数据并投资于相关技术。现在它们希望能从这个“数据堆栈”中获益。AI提供了路径。

毫不意外，最先拥抱AI的行业就是科技业。从本世纪初开始，机器学习技术就为谷歌在线广告业务的发展提供了强劲动力。现在，谷歌还利用AI来优化搜索结果，在你写Gmail邮件时帮忙补全句子，以及想办法减少其数据中心的能耗。亚马逊利用AI管理供应链，对仓库机器人下指令，并预测哪些求职者未来能胜任工作；苹果用AI驱动数字助手Siri；Meta用AI奉上博人眼球的社交媒体帖子；微软也用AI做很多事情，从帮助消除其视频会议服务Teams中的背景噪音，到帮用户创作ppt初稿。

科技巨头很快嗅到了商机，把其中一些AI功能照样出售给客户。亚马逊、谷歌和微软现在都为其云计算部门的客户提供这类工具。微软机器学习云服务的收入已经连续四个季度同比翻番。新晋供应商的数量也在激增，比如加拿大的仓库扫地机器人开发者Avidbots、开发应用来帮助销售团队跟进客户线索的Gong等。云计算的推广降低了使用AI的成本，使这项技术能够扩展到从工业到保险的其他各个领域。你可能没有留意到，但如今AI实则已无处不在。

| 磨平刀锋

2006年，牛津大学的尼克·博斯特罗姆（Nick Bostrom）表示，“一旦某

这个东西变得非常有用且很常见，它就不再被归为AI”。Databricks公司帮助客户管理AI类应用的数据，老板阿里·高德西（Ali Ghodsi）注意到了这种“无聊AI”的爆炸式增长。他认为，未来几年，AI将被应用到越来越多的工作岗位和公司职能中。AI预测能力的大量小步提升能带来更好的产品，节约大笔成本。

这在一些不那么引人注目的领域尤其如此，这些领域里的企业已经开始使用一些分析技术，比如用来管理供应链。今年9月，飓风“伊恩”导致沃尔玛被迫关停了一个大型配送中心，导致向佛罗里达的超市运货中断。沃尔玛采用了一种新的AI供应链模拟技术，重新安排从其他配送中心送货的路线，并预测飓风过后商品需求会发生哪些变化。沃尔玛技术部门的斯里尼·文卡特桑（Srin Venkatesan）表示，有了AI，这些工作只花了几小时而不是几天。

即将涌现的新一波基础模型可能会让更多AI技术变得平凡无奇。这些算法给商业带来了两大潜能。首先是基础模型能够生成新的内容。Stability AI和Midjourney这两家创业公司创建的生成式模型可以根据特定提示词生成新图像。比如，你想要一幅独轮车上的狗的图像，毕加索风格的；或者正经一点，给一家新创业公司设计一个logo，算法都会在一分钟左右的时间里炮制出来。还有一些创业公司是在其他公司的基础模型之上构建应用。Jasper和Copy.AI都向OpenAI付费来使用GPT3，让自己的应用可以把简单的提示词转换为营销文案。

第二个好处是，基础AI在经过训练后擅长执行各种任务，而不只是某个专门的任务。以GPT3为例，它是OpenAI开发的自然语言处理模型，是ChatGPT的基础。首先要在互联网的大量数据块上训练它，然后由不同的创业公司对它做微调，让它能干各种活，比如撰写营销文案、填写税务表格，以及根据一系列提示文字创建网站等。咨询公司德勤（Deloitte）的AI业务主管比纳·安曼纳特（Beena Ammanath）粗略估计，基础模型的多功能性可以让AI项目的成本降低20%至30%。

同样可以想见的是，生成式AI的一项早期的成功应用也会出现在科技业

内：计算机编程。有几家公司正在推出一种虚拟助手，它接受过大量代码的训练，可以根据提示写出新的代码。比如微软旗下托管开源程序的平台GitHub上的Copilot。使用Copilot，程序员可以减少近40%的代码编写工作。GitHub声称这将编程速度提高了50%。6月，亚马逊推出了它自己的代码助手CodeWhisperer。据报道，Alphabet正在公司内部使用代号为PitchFork的类似的工具。

| 人工添彩

今年5月，微软的老板萨蒂亚·纳德拉（Satya Nadella）宣称：“我们希望有朝一日，世界上每个人，无论从事什么职业，在做任何事情时都能用上Copilot。”10月，微软推出了一款工具，可以根据提示词为用户自动整理数据。亚马逊和谷歌可能会尝试开发类似的产品。好几家创业公司也已经在做这件事。加州公司Adept的经营者之前曾供职于Deepmind、OpenAI和谷歌，联合创始人凯尔西·斯佐特（Kelsey Szot）表示，Adept正在开发“一个面向知识型员工的Copilot”。9月，该公司发布了它的第一个基础模型的视频，该模型可以根据提示处理电子表格中的数字，并在房地产网站上进行搜索。Adept计划为商业分析师、销售人员和其他企业岗位开发类似的工具。

企业用户正在尝试其他利用生成式AI的新颖方式。约翰迪尔的桑切斯表示，公司正在研究AI生成的“合成”数据，这可以帮助训练其他AI模型。去年12月，运动服饰巨头耐克收购了一家使用这种算法来设计新款运动鞋的公司。亚马逊的虚拟助手Alexa现在可以编故事给孩子们听。瑞士食品巨头雀巢正在使用另一个OpenAI模型DALIE-2创作的图像来帮助推销酸奶。一些金融公司也在利用AI起草季度报告。

基础模型的用户还可以利用一个新兴行业——职业提示员。这些人制定操作指南以优化模型输出。PromptBase是一个可供用户买卖提示词的市场，这些提示词可以让DALIE-2和Midjourney等基于图像的大型生成式模型输出精美的画作。该网站还能让你聘请专业的“提示工程师”，其中一些人每个词收费50至200美元不等。“现在归根到底就是写提示词了。”GitHub的老板托马斯·多姆克（Thomas Dohmke）表示。

与所有强大的新工具一样，企业在部署更多AI时必须谨慎行事。由于是在互联网上接受训练，许多基础模型都会如实反映人性，当然也就包括丑陋的一面。斯坦福大学的学者研究发现，如果要求GPT3把以“两个穆斯林走进.....”开头的句子补充完整，结果提及暴力的可能性要比用“基督徒”或“佛教徒”作主语时大得多。在有人指出其科学基础模型Galactica会生成看似真实、但实际是胡编乱造的研究成果后，Meta下架了这个模型。位于西雅图的华盛顿大学的生物学家卡尔·伯格斯特罗姆（Carl Bergstrom）称它是“胡扯生成器”。（Meta表示，想要了解这个模型的科研人员仍然可以使用它。）

其他问题是商业界特有的。因为基础模型往往是黑箱，无法解释自己的结果从何而来，一旦出差错，它们可能会带来法律责任。对于那些不清楚自己想用AI做什么、或者没有教会员工如何使用AI的公司，它们不会起多大作用。这或许有助于解释为什么在麦肯锡调查的受访者中，只有四分之一表示AI促进了盈利（指至少让利润提升5%）。而看到了较大益处（利润提升超过20%）的公司只占小个位数的百分比，而且其中许多是科技公司，参与这项研究的迈克尔·崔（Michael Chui）表示。

不过，随着更多AI变得越来越平平无奇，这一比例势必会继续攀升。难得有无聊之事让人如此兴奋。 ■



The Economist Film

Why are black holes important? Part 2

If you can find out what's in the middle of black hole, you've solved physics basically.



经济学人视频

黑洞为何重要？（下）

如果能弄清黑洞里的状况，就基本理清了整个物理学。



Tales of the megacity

Can Tokyo's charms be replicated elsewhere?

Outsiders once disparaged Japan's capital. Now it has lessons to offer

THE REAL Tokyo, as any denizen of the world's most populous metropolis knows, is found in the smallest of spaces. Japan's capital is not a city of grand arterial boulevards. Its lifeblood flows instead through tangles of narrow alleys, up the stairs of slim buildings and into tiny shops and cramped eateries.

Take Nonbei Yokochō, or Drunkard's Alley, a charmingly defiant cluster of watering holes in the shadow of Shibuya railway station. The average size of the 38 establishments is just under five square metres, notes "Emergent Tokyo", a new book by Jorge Almazán, an architect, and his colleagues at Keio University. They nominate Tokyo as a model of a liveable megacity and explore its workings—and in so doing show how perceptions of it have evolved.

For much of its modern history, it was "the world city that everyone loved to knock", observes Paul Waley, author of several books on it. Tokyo did not conform to traditional notions, Western or Chinese, of how a city should look, feel and function. In place of neat street grids that signal order and authority, it had a patchwork of meandering neighbourhoods. Disasters left little in the way of visible heritage. There is no overarching style or sense of monumentality. Visitors have often been baffled and underwhelmed: in the late 19th century Isabella Bird, a British traveller, dismissed Tokyo as "a city of 'magnificent distances' without magnificence".

Edo, as Tokyo was first known, grew only when the Tokugawa shoguns chose it as their seat of power after consolidating control of Japan at the start of the 17th century. Some areas expanded along Chinese-style grids

and others according to the topography of the land. They interlocked with one another in a kind of calculated incoherence, much like “a patchwork quilt”, writes Timon Screech in “Tokyo Before Tokyo”, published in 2020.

Though Kyoto remained home to the imperial family, and was thus the official capital, Edo soon became pre-eminent. By the early 1720s it had a million inhabitants and was the world’s largest city. Culture flourished, despite the earthquakes and fires that periodically struck. After the Meiji restoration brought an end to the Tokugawa shogunate and opened Japan to the world in 1868, the emperor moved to Edo. It was renamed Tokyo—literally, “The Eastern Capital”.

Industrialisation and Western influence began to transform it. Grand Haussmann-esque plans for reconstruction were discussed but never realised, not even after the Great Kanto Earthquake of 1923 flattened the city. After the second world war, when American firebombing razed Tokyo again, planners tried to impose order, erecting hulking concrete expressways over the canals that had earned Edo comparisons to Venice. Yet the planners’ reach was limited, and much of the rebuilding happened haphazardly, from the bottom up.

As Tokyo thrived in the post-war era, so did interest in its past, producing a boom in so-called Edo-Tokyo Gaku, or Edo-Tokyo Studies. In “Tokyo: A Spatial Anthropology”, a seminal book published in 1985, Jinnai Hidenobu, an urban historian, argued that the rhythms of the Edo era had endured, even if the individual buildings had vanished. “There was no clear logical system in Edo that would bring a variety of elements together into a single whole as in a European city,” he wrote. Rather, “like a mosaic or a kaleidoscope”, the metropolis “sparkled with myriad different images created by the particularity of individual locales, their terrain and their histories”.

| *The virtues of disorder*

As, across the world, Modernist ideals of unity and clarity gave way to a post-modern embrace of disorder, Tokyo's kaleidoscope came to be regarded differently. Its hectic neon streets began to look like a vision of the future. All the same, its admirers often fell back on a kind of cultural essentialism, attributing Tokyo's magic to uniquely Japanese conditions. There might be plenty in the city to envy, but it seemed there was little point in trying to emulate it.

In the 21st century the city has become a source of insights for urbanists and architects elsewhere. Tokyo today is unusually liveable—safe, clean, functional and vibrant—for a megacity of its size: 37m in its greater metropolitan area, including 14m people in the central wards. World-class infrastructure stitches together neighbourhoods that retain the intimate qualities of smaller communities.

Contemporary observers tend to focus on the advantages of Japan's relatively permissive zoning laws. Those support the theories of Jane Jacobs, a mid-20th-century American writer who challenged the orthodoxy that cities should be organised by function. As André Sorenson notes in "The Making of Urban Japan", Tokyo shows how dense, mixed-use neighbourhoods can enliven a city. Many of its best bits were the least planned.

"Emergent Tokyo" is a valuable addition to what it calls "Tokyology". Mr Almazán and his team use a mix of number-crunching, shoe-leather reporting and lush images to explain how and why the city works. Municipal data help illuminate recurring features, from the teeming yokocho alleyways to the neon-signed buildings known as zakkyo. The authors attribute Tokyo's success to prosaic policy choices rather than an abstract national essence. The eclectic façades of the zakkyo, for example, result not from a Japanese disregard for exteriors, as commentators once

argued, but the fact that ordinances apply to each building independently. Owners are not required to blend in with other buildings, as is often the case in Western cities.

Within this looser framework, says Mr Almazón, Tokyo's most characteristic elements generally "emerge" organically rather than being imposed from above, as owners and designers respond to the decisions of their neighbours, much as a flock of birds finds its shape. Yokochō, for example, grew out of the black-market street stalls that proliferated immediately after the war. After being granted land rights, owners banded together to protect themselves as developers encroached.

In Nonbei Yokochō the valuable land under the bars is held collectively and managed through a trust. The fragmented ownership and low overhead costs help facilitate economies not of scale, but of agglomeration, with rows of idiosyncratic spaces that feel personal, informal and intimate. Despite their small size, the bars offer plenty to drink—and plenty for other cities to ponder. ■



超大城市的前世今生

东京的魅力能在其他地方复制吗？

外人曾对日本的首都嗤之以鼻。现在它有经验可教了

住在这个世界上人口最多的大都市里的人都知道，真正的东京藏在最细微处。日本首都的精髓不在宽阔的林荫大道。相反，它的生命力流淌在纵横交错的小巷里，在狭小建筑的楼梯上，在小商铺和狭促的食肆中。

饮兵卫横丁（字面意思是“酒鬼巷”）就是一个例子，这条位于涩谷站附近的小巷遍布小酒馆，散发着桀骜不驯的迷人气息。建筑师豪尔赫·阿尔马赞（Jorge Almazán）和他在庆应义塾大学的同事们在新书《自然生长的东京》（Emergent Tokyo）中写道，这38家居酒屋的平均面积不到5平方米。他们称东京为宜居大都市的典范，探究了它的运作模式，在此过程中也展示了人们对东京印象的演变。

在它进入现代以后的大部分时间里，东京是个“人人都喜欢对它评头论足一番的世界城市”，曾就东京写过几本书的保罗·韦利（Paul Waley）评论道。在一个城市该像什么样、给人什么感觉、有些什么功能方面，东京不顺应传统观念，无论是西方的还是中国的。这里没有象征着秩序和权威的整齐街道，只有形形色色蜿蜒曲折的街区。灾难几乎没有留下看得见的印记。它没有整体风格，也没有宏伟雄壮之感。游客们常常觉得看不懂它又索然无味：19世纪末，英国旅行家伊莎贝拉·伯德（Isabella Bird）将东京嗤之为“一个‘远得惊人’却毫不惊人的城市”。

东京最初被称作“江户”，直到17世纪初德川幕府巩固对日本的控制后选择这里作为权力中心，它才发展起来。它的一些区域按照中式的网格布局扩展，另一些依地势扩张。泰门·斯克里奇（Timon Screech）在2020年出版的《东京之前的东京》（Tokyo Before Tokyo）中写道，各个区域之间交错扣连，不过呈现出某种有意为之的不相一致，好像“一条百家被”。

虽然京都仍是皇室所在地，因此是官方首都，但江户很快就声名赫赫。到

18世纪20年代初，它已有百万居民，是世界上最大的城市。尽管不时发生地震和火灾，但文化蓬勃发展。1868年，明治维新终结了德川幕府的统治，日本对外开放，天皇迁居江户。它改名为“东京”——字面意思是“东都”。

工业化和西方的影响开始改造这座城市。人们讨论过宏伟的奥斯曼式重建计划，但从未实施，哪怕是在1923年关东大地震把这座城市夷为平地之后。二战时美国的燃烧弹再次将东京夷平，战后的规划人员想要建立秩序，在江户堪比威尼斯的运河上建起了庞大沉重的混凝土高速公路。但是规划人员的触及范围有限，大部分重建都是自下而上随意发生的。

随着东京在战后繁荣发展，人们对它的过去也兴趣高涨，推动了所谓“江户东京学”的兴盛。1985年出版的《东京的空间人类学》（Tokyo: A Spatial Anthropology）影响深远，其作者、城市历史学家阵内秀信认为，即便单个的建筑消失了，江户时代错综变化的布局仍在延续。“江户不像欧洲城市那样有一个清晰的逻辑系统，能将各种元素整合成一个整体，”他写道，相反，“它就像马赛克或万花筒”，这座大都市“五光十色，每一处都有其地形和历史而来的特质，造就了无数熠熠生辉的各异形象”。

| 无序的优点

在世界各地，现代主义对统一和清晰的追求让位给后现代对失序的拥抱，人们对东京的万花筒特质又有了不一样的看法。霓虹绚烂的街道开始呈现出一幅未来的图景。尽管如此，东京的推崇者们却常常倒向一种文化本质主义，将东京的魔力归因于日本独有的条件。这座城市可能有很多值得羡慕的地方，但试图模仿它似乎没什么意义。

来到21世纪，东京已经成为其他地方的城市规划师和建筑师观察与洞见的源泉。就一个超大规模的城市（3700万人居住在大都会区，其中1400万人在中心城区）而言，今天的东京是一个异常宜居的城市——安全、清洁、功能齐全、充满活力。世界一流的基础设施把各个保留了小社区亲密特质的街区缝接在一起。

当代的观察人士大多聚焦日本相对宽松的城市区划法的优点。它们支持了20世纪中期美国作家简·雅各布斯（Jane Jacobs）的理论。雅各布斯质疑城市应当按功能划分区域的正统观念。正如安德烈·索伦森（André Sorenson）在《日本城市的形成》（The Making of Urban Japan）中指出的那样，东京展示了密集且混合用途的社区是怎样让一个城市生机勃勃。它的许多精华部分恰恰不是规划带来的。

《自然生长的东京》是对所谓“东京学”（Tokyology）的宝贵补充。阿尔马赞和他的团队用大量数据、实地报道和丰富的图片多方面解释了这个城市如何以及何以能够这般运作。市政数据帮助阐明了一些反复出现的特点，从熙熙攘攘的横丁小巷，到挂满霓虹灯招牌的“杂居”建筑。作者将东京的成功归因于平平无奇的政策选择，而非抽象的国民特质。比如，杂居建筑不拘一格的外立面并不像评论家曾经认为的那样，源于日本人对外观的满不在乎，而是因为每栋建筑要分别遵守不同的管理条例。法规并不要求业主让物业和其他建筑风格相融，而西方城市往往有这样的要求。

阿尔马赞说，在这个更宽松的框架中，东京最具特色的元素通常是有机地从内部“生长”，而不是自上强加而来的，业主和设计师对邻居的决定做出回应，很像是一群鸟儿形成队形。例如，横丁是在战后迅速涌现的黑市街头摊位的基础上发展起来的。在获得土地权后，业主们联合起来抵御开发商入侵。

在饮兵卫横丁，居酒屋下方的昂贵土地为集体所有，由信托管理。分散的店铺所有权和较低的营业成本不能促进规模经济，但会促进聚集经济，这里一排排特立独行的空间让人觉得个性化、轻松随意且亲密。尽管店面很小，但这些小酒馆有很多酒水可选择，也有很多地方值得其他城市深思。





Arabs looking east

The Gulf looks to China

A summit in Saudi Arabia will be about energy and money—and sending a message to America

THE MOOD on the Arabian peninsula was jittery. After an abrupt surge, oil prices were sliding amid a rich-country recession. Conflict brewing in the Persian Gulf left Saudi Arabia worried about attacks on its oilfields and eager to procure ballistic missiles to deter its rivals. Rebuffed by America, a young and powerful Saudi prince turned instead to China, which signed a secret deal to supply the kingdom with the weapons it wanted.

If this story evokes a sense of déjà vu, it most certainly should. It happened four decades ago and led to the establishment of Sino-Saudi relations in 1990. Much of it has echoes today, as Xi Jinping arrived for a visit to Saudi Arabia on December 7th, his second trip to the kingdom.

Not everything is the same, of course. In contrast to the 1980s, Saudi Arabia and its Gulf neighbours now have strong commercial ties with China. Still, plus ça change: the Saudis continue to treat China as a foil for America, which in their eyes has become a particularly unreliable partner over the past decade.

The challenge for Gulf states is how to balance these two views of China. The first has become increasingly alluring. China is a big export market and a major source of investment in the Gulf. The second, in which China serves as a strategic hedge against an erratic America, is less compelling: China is no easy substitute. Moreover, in trying to play one power off against the other, Gulf leaders may hasten America's abandonment of them, which they fear.

Start with the Gulf's economic relationship with China, which is growing. Energy remains at the core. Last year 51% of China's oil imports came from Arab states, and four-fifths of that came from the monarchies of the six-member Gulf Co-operation Council (GCC). In November Sinopec, a state-run energy giant, signed a 27-year agreement to buy liquefied natural gas from Qatar, the longest such gas deal ever.

Since 2005 China has signed large investment deals and construction contracts with Arab states worth \$223bn, says the American Enterprise Institute, a think-tank in Washington. Of that total, 52% has been with the GCC countries (Algeria, Egypt and Iraq took much of the rest). The pace of those deals speeded up in the late 2010s (see chart). Though it has since slowed, due to the pandemic and a slump in Chinese investment worldwide, China continues to see the Gulf as promising. In the first half of 2022 Saudi Arabia received \$5.5bn in investment and contracts through China's Belt and Road Initiative, more than any other country.

Much of this investment remains focused on energy. Trade is oily too: Chinese imports from the region are almost entirely petrochemicals and other commodities. Gulf states are keen to shift their economies away from oil and view China as a key partner in that effort. Last year it pumped money into hotels in Oman and auto-manufacturing in Saudi Arabia. Such projects are still outliers, though; non-oil investment remains sluggish.

None of this causes much angst in America. It is the Gulf's growing ties with China in strategic sectors that worry people in Washington: telecoms, security and, increasingly, defence. GCC members are keen customers of Huawei, the telecoms giant that is under American sanctions, and are happy to do business with companies like SenseTime, an artificial-intelligence firm blacklisted by America for its role in spying on Uyghurs in Xinjiang. In September a company owned by Saudi Arabia's sovereign-wealth fund announced a \$207m joint venture with SenseTime to build an

AI lab in the kingdom.

China has also sold armed drones to the UAE, among others, which has used them on battlefields across the region. In March a Saudi firm signed a deal with a state-owned Chinese defence giant to manufacture drones in the kingdom. America's spies say China is helping Saudi Arabia build ballistic missiles as well.

Last month at the Manama Dialogue, an annual security powwow in Bahrain, American officials came with warnings. Brett McGurk, the president's Middle East adviser, said growing co-operation with China in the region would put a "ceiling" on relations with America. Another official acknowledged the tensions in the relationship, particularly over Iran.

Mr Xi is being more warmly received than Joe Biden, whose trip to Saudi Arabia in July, his first as president, had an air of desperation: oil prices were high, an election loomed, and he needed help. The Saudis sent him home empty-handed. After more than a year of froideur from his people, they were in no mood to be generous.

Mr Xi, by contrast, will probably go home with a stack of big investment deals and other announcements. He was due to meet the Saudi leadership, including Muhammad bin Salman, the crown prince and de facto ruler, on December 8th. Next on his schedule is a summit with Gulf leaders and a further meeting with figures from across the Arab world. Saudis joke about the prospect of the taciturn Mr Xi joining a traditional sword dance.

Saudi officials insist that none of this is meant as a snub to America: China is an important country, they say, and the kingdom treats it as such. Still, the Biden team has had a tricky relationship with Saudi Arabia and sees China as its main competitor. The chummy reception for Mr Xi—in contrast to the frosty one for Mr Biden—will not go down well in Washington.

In private, Gulf officials say they are exasperated with an America whose policy seems incoherent. Three consecutive presidents have talked of reducing America's role in the Middle East, yet they do not want other powers to gain too much influence as they depart. Such frustrations in the Gulf are understandable.

But so too are America's. The GCC complains that America has not done enough to protect it from the Gulf Arabs' arch-rival Iran, with which China signed a 25-year "strategic partnership" last year. Mr Xi is one of the few leaders with real leverage over Iran. Most of the oil exported from Iranian ports, in defiance of American sanctions, finds its way to Chinese refineries. Yet he is loth to use it to bring pressure on Iran's government.

Buoyed by higher oil prices and growing economies, Gulf rulers feel assertive: they think this is their moment to step out from America's shadow. Mr Biden will have to accept a greater Chinese role in the region. But both sides should recognise that, now as in the 1980s, China cannot fully replace America in the Gulf. ■



阿拉伯人向东看

海湾国家指望中国

中阿峰会关乎能源和投资，也会向美国发出信号

阿拉伯半岛上的气氛一度紧张不安。油价先是突然飙升，继而随着富国经济衰退而下滑。波斯湾冲突酝酿，让沙特阿拉伯担心油田受到攻击，急于采购弹道导弹威慑对手。向美国求购被拒后，一位大权在握的年轻沙特王储把目光转向中国，两国签署了一项秘密协议，向沙特供应它想要的武器。

这听来仿佛似曾相识，那就对了。四十年前曾有过类似的事情，促成了1990年中沙建交。这一切如今大有重演之势：12月7日，习近平抵达沙特，展开他对该国的第二次国事访问。

当然，事情并非一模一样。相比上世纪80年代，沙特等海湾国家现在和中国的商业联系已相当紧密。然而，万变不离其宗：沙特人继续把中国用作美国的陪衬品，在他们眼中，美国这个伙伴在过去十年里已经变得特别不可靠。

海湾阿拉伯国家面临的挑战是如何平衡对中国的以下两种看法。越来越多人倾向第一种：中国是个庞大的出口市场，也是海湾地区的一大投资来源。第二种认为，面对捉摸不定的美国，中国可充当一种战略对冲。但这种观点没那么令人信服，因为中国不能提供一种简单的替代。而且，海湾领导人这种借助一个大国来牵制另一个的做法可能会加速美国离弃他们，而这正是他们所担心的。

先来看海湾地区与中国之间日渐紧密的经济关系。能源依然是核心。去年，中国51%的石油进口自阿拉伯国家，其中五分之四来自海湾合作委员会（GCC，以下简称“海合会”）的六个君主制成员国。11月，国有能源巨头中石化签署了一项为期27年的协议，从卡塔尔购买液化天然气，是有史以来期限最长的此类交易。

据华盛顿智库美国企业公共政策研究所（American Enterprise Institute）估计，自2005年以来，中国与阿拉伯国家签署了总值2230亿美元的大型投资协议和建设合同。其中有52%是与海合会成员国签订的，其余部分主要来自阿尔及利亚、埃及和伊拉克。这些协议的签订在2010年代后期加速（见图表）。此后虽然因为新冠疫情和中国在全球的投资减少而有所放缓，但中国仍看好海湾地区。2022年上半年，沙特通过中国的“一带一路”倡议获得了55亿美元的投资和合同，比任何其他国家都多。

这里面的投资大部分仍旧集中在能源领域。贸易也大多与石油相关。中国从海湾地区的进口几乎全部是石化产品等大宗商品。海湾国家渴望从石油经济转型，并视中国为这一努力的关键伙伴。去年，中国投资了阿曼的酒店业和沙特的汽车制造业。但这些项目仍属少数，非石油投资依然低迷。

这一切并未引发美国太多的不安。让华盛顿的官员担心的是海湾国家与中国在战略性部门日益紧密的联系，包括电信、安全，还有越来越多的国防业务。海合会成员国是中国电信巨头华为（受美国制裁）的忠实客户，而且乐于与商汤科技（一家中国人工智能公司，美国宣称该公司产品被用于监视新疆维吾尔人而将其列入黑名单）等公司做生意。9月，沙特主权财富基金旗下的一家公司宣布联手商汤科技成立一家价值2.07亿美元的合资企业，在沙特建设一个人工智能实验室。

中国还向阿联酋等国出售武装无人机，阿联酋已在海湾地区战场上使用了这些无人机。3月，沙特一家公司与中国一家国有国防巨头签署协议，将在沙特境内制造无人机。美国情报人员称，中国还在帮助沙特制造弹道导弹。

上个月，在巴林举行的年度安全会议麦纳麦对话会（Manama Dialogue）上，美国官员发出了警告。美国总统的中东事务协调员布雷特·麦格克（Brett McGurk）称，海湾国家与中国在该地区加强合作会让前者与美国的关系触“顶”。另一位美国官员承认双方关系紧张，特别是在伊朗问题上。

沙特对习的到访比对拜登更热情。7月，拜登上任后的首次到访带着一丝绝望挣扎的气息：油价高涨，中期选举逼近，他需要帮助。沙特人却让他空手而归。被美国人冷落了一年多，他们可大方不起来。

相比之下，习这次可能带着诸多大型投资协议及其他合作计划满载而归。他会在12月8日会见沙特领导人，包括实际统治者、王储穆罕默德·本·萨勒曼（Muhammad bin Salman）。接下来的安排是与海湾地区领导人举行峰会，然后是和整个阿拉伯世界的精英人士会面。沙特人笑说期盼看到不苟言笑的习和他们一起跳传统剑舞。

沙特官员坚称这些并非有意怠慢美国。他们说中国是个重要国家，沙特待之以相应规格。但毕竟拜登团队与沙特的关系复杂微妙，又视中国为主要竞争对手。对比拜登受到的冷遇，沙特对习的盛情款待肯定会让华盛顿心生芥蒂。

海湾国家官员私下说他们受够了一个政策反复摇摆的美国。连续三任美国总统都声称要弱化美国在中东的角色，但他们在自己抽身之际又不想让其他大国在中东取得太大的影响力。海湾国家的这种恼火情绪是可以理解的。

但美国的烦恼也是可以理解的。海合会抱怨称，美国没尽力保护海湾阿拉伯国家抗衡宿敌伊朗，而中国去年与伊朗签署了为期25年的“战略伙伴关系”。习是少数几个能真正对伊朗施加影响的领导人之一。违反美国制裁从伊朗港口出口的石油大多流入了中国的炼油厂。但他不愿借此对伊朗政府施压。

在油价上涨和经济增长的鼓舞下，海湾国家的统治者自信满满，认为这是他们走出美国的影子的时刻。拜登将不得不接受中国在海湾地区影响力上升的事实。但双方都应该认识到，现在和上世纪80年代时一样，中国不可能在该地区完全取代美国。 ■



Lexington

Elon Musk is showing what a waste of time Twitter can be

He, and his critics, should remember the meaningful work he is capable of

“RUB IT OUT!” stormed Henry Ford when his sensitive son Edsel summoned the courage to present him with a proposal to modernise the Model T. It was 1924, and Edsel saw the threat posed by the stylish cars emerging from General Motors. General Motors, of course, would go on to become the world’s biggest carmaker and then the acme of sluggishness. To learn how to make better cars, it spent billions creating a new company, Saturn, and undertaking a joint venture with Toyota at a factory in Fremont, California. Both attempts to overcome inertia failed.

Yet now automakers not just in America but around the world are panting to transform the very nature of their vehicles. That is in no small part thanks to the company that paid next to nothing for the idle plant in Fremont and started making electric cars there. To the dismay of a short-selling multitude, Tesla proved to be the first successful startup in the American car industry since Chrysler, which was founded in 1925.

Rapturous about internal combustion—they could veer toward poetry when discussing its roar and smell—American car executives used to scoff at electric vehicles. Their forays into the technology yielded mediocrities that they seemed to hope would disillusion the tree-huggers who bought them. By showing the electric car could be glamorous, Elon Musk changed the industry.

Around that same time he was rejuvenating another doddering industry. Few experts thought SpaceX could succeed, either. They scorned the idea that anyone would entrust a satellite to a reusable rocket, a far cheaper option. Yet this year SpaceX, the low-cost ticket to orbit, is launching about

a rocket a week. America is leading an industry it had all but ceded to Russia and is boldly planning ventures into the solar system once again.

You will read some of the less appealing bits about Mr Musk shortly. It seemed worthwhile first to note a couple of his achievements—he also helped lead what became America's largest installer of solar panels—because of the condescension and even hate bucketing upon him from America's left-leaning press these days. Sam Bankman-Fried may have built his reputation as a visionary upon sand, but it is Mr Musk who has become the face of capitalist perfidy. Yet has any other business person (or, let's face it, journalist) done as much to combat climate change? Or to save democracy in Ukraine, where Mr Musk's Starlink satellite network has kept the government, citizens and soldiers online?

The contempt for Mr Musk says something about the press and about Mr Musk, and a lot about Twitter. Twitter has never been among the most popular social networks, but since launching in 2006 it has been an efficient means for discovering links to important news and big ideas. Probably for that reason it has been disproportionately valued by those who traffic in such things, including politicians, politically minded celebrities and journalists.

Yet Twitter has also proved to be a lousy medium for discussing important news and big ideas. It disdains nuance, amplifies misstatement and rewards conflict, cruelty and trolling. These are reasons Twitter's most adept user was probably Donald Trump. (In "Confidence Man", Maggie Haberman reports that an aide compared the moment Mr Trump first pecked out his own Tweet, rather than dictating it, to the scene in "Jurassic Park" when dinosaurs discover they can open doors themselves.)

Like Mr Trump, other politicians, celebrities and journalists discovered they could deploy Twitter best to market themselves, courting followers by

applauding certain points of view and condemning others. As a result, within the chattering classes, Twitter has become a powerful enforcer of conformity.

When Mr Musk took over Twitter in late October, a kind of mass hysteria seized those obsessed with the platform. Though bemoaning Twitter's toxicity has been a staple of its habitués for years, many became convinced it turned venomous overnight. Then one evening in mid-November, the herd decided Twitter was about to collapse; many wrote poignant farewells, recalling the good times. As Twitter perversely endured, some denizens urged their "followers"—why does anyone embrace that label?—to flee to other platforms, even as they kept tweeting. Mr Musk's decision to allow Mr Trump back onto the platform was the last straw for a few, though why Mr Trump was beyond the pale and Nicolás Maduro just fine was the kind of question Twitter had no time for.

| *No way to save humanity*

The grandiosity and superficiality make for classic Twitter. But it is less amusing that Mr Musk is exemplifying the foolishness. He is at risk of turning himself into a spokesmodel for everything shoddy and obnoxious about his product. There is a principled argument for giving Mr Trump another chance on Twitter, but Mr Musk did not make it. Instead he polled users. He has tweeted insults, sexist tropes and at least one conspiracy theory, and raised doubts even about his idea of free speech. He has delighted in trolling critics. That is understandable (just about everyone who is Twitter-famous does it), but it seems unwise for Twitter's owner to act like just another of its tribal warriors. As Twitter has done to others, it may take his point of view—libertarian, contrarian—and make it harsher, more performative, much less interesting.

Above all, Mr Musk is demonstrating what a frivolous distraction Twitter can be. "The point is to maximise the probable lifespan of humanity," he

once told a biographer, Ashlee Vance, in explaining why he was devoted to turning humans into a multiplanetary species. It would be arrogant to bet against Mr Musk, but if civilisational transcendence is the ambition, Twitter seems like a crazier moon shot than SpaceX or Tesla ever was. Maybe he will turn Twitter into the constructive public square he envisions, making it a truthful resource and revitalising America's bloated, unreliable news industry. But, for now, Twitter seems like a waste of his time, even more than it is for everyone else. ■



列克星敦

马斯克展示了推特有多浪费时间

他本人以及他的批评者应该记得他原本能做多么有意义的工作

“擦掉！”当性情敏感的埃德塞尔（Edsel）鼓起勇气向父亲展示福特T型车的改造方案时，亨利·福特怒喝道。这一幕发生在1924年，彼时埃德塞尔看到了通用汽车推出的各种新潮车型带来的威胁。当然，我们都知道接下来通用汽车会成为世界上最大的汽车制造商，然后又沦为怠惰的典范。为了掌握更先进的造车技术，通用汽车曾花费数十亿美元创办了新的土星公司（Saturn），还在加州的弗里蒙特（Fremont）与丰田成立了合资工厂。这两次试图克服惰性的努力都以失败告终。

然而现在，不只是在美国，全球各地的汽车制造商们都渴望改变汽车的本质。这在很大程度上要归功于特斯拉。它几乎没花什么钱就买下了弗里蒙特那座闲置的工厂，并开始在那里生产电动汽车。事实证明，特斯拉是自1925年克莱斯勒成立以来美国汽车业第一家成功的创业公司，这让众多做空它的人沮丧不已。

想当初美国车厂的高管们如此迷恋内燃机——谈起它的轰鸣和气味简直诗兴大发，而对电动汽车总是嗤之以鼻。他们试水电动汽车技术的结果乏善可陈，好像是专门为了让买这些车的环保主义者死心一般。马斯克展示了电动车也可以魅力四射，以此改变了整个行业。

差不多同一时期，他还在重振另一个日渐式微的行业。当时几乎也没有专家看好SpaceX。他们很不屑，竟有人放心把卫星交给可回收的火箭，尽管费用会大大降低。然而今年，实现了低成本轨道发射的SpaceX大约每周发射一次火箭。目前美国在这个曾经差点拱手让给俄罗斯的行业里领跑，并且正在大胆规划再次探入太阳系。

接下来说说马斯克一些不那么令人钦敬的地方。鉴于这些天来美国左翼媒体对他暴风骤雨般投去的轻蔑甚至憎恨，似乎应该先把他的成就列举一二

——他还协助领导了一家已成为美国第一大太阳能电池板安装商的公司。FTX的创始人萨姆·班克曼-弗里德（Sam Bankman-Fried）可能留下了空想家的声名，但马斯克却成了资本家背信弃义的代表。然而，还有哪位商人（或者，承认吧，哪位媒体人）在对抗气候变化、亦或在拯救乌克兰民主方面（他的“星链”卫星系统让乌克兰的政府、民众和士兵都能继续联网）做得和马斯克一样多？

对马斯克的轻蔑道出了关于媒体和马斯克的些许事，也道出了关于推特的很多事。推特从来不在最受欢迎的社交网络之列，但自2006年创立以来，它为人们提供了发现重要新闻和重大思想的线索的有效途径。可能正因如此，经营这类东西的人——包括政客、有政治头脑的名人以及新闻工作者等——对它格外重视。

然而事实也证明，推特在讨论重要新闻和重大思想方面却是个糟糕的媒介。它不屑于区分细微差别，放大虚假和错误信息，鼓励冲突、残暴和煽动挑衅。因此，最善用推特的用户可能是特朗普。玛吉·哈伯曼（Maggie Haberman）在《骗子》（Confidence Man）一书中写道，当特朗普第一次用手指头在手机上一字一句地敲出而不是向助手口述推文时，这名助手仿佛看到了《侏罗纪公园》中恐龙发现可以自己开门那一幕。

和特朗普一样，其他政客、名人和媒体人发现，他们可以利用推特来充分营销自己，通过赞扬某些观点同时谴责其他观点来迎合粉丝。结果是在“聒噪阶层”当中，推特已经成为寻求他人一致附和的有力工具。

当马斯克在10月下旬接管推特时，那些沉迷于这个平台的人陷入了一种集体歇斯底里。尽管多年来哀叹“推特有毒”在其铁杆用户中已是老生常谈，但许多人还是开始相信它是一夜之间变成仇恨言论的泛滥之地的。然后到了11月中旬的一个晚上，这群人认为推特即将垮掉；许多人写下沉痛的告别语，回忆逝去的美好时光。而推特却顽强地继续存活了下来，一些红人一边催促自己的“粉丝”逃到其他平台（为什么会有人欣然接受“粉丝”这种标签？），一边却还不停地发推文。对一些人来说，马斯克允许特朗普重返推特的决定是压垮他们的最后一根稻草。不过为什么无法接受特朗普，

却可以接受委内瑞拉总统马杜罗，这种问题可不是推特愿意去琢磨的。

| 拯救人类无门

这种浮夸和肤浅是推特的典型特征。但马斯克正在亲自示范它的愚蠢，这就让人笑不出来了。他有可能把自己变成推特所有粗制滥造和令人讨厌的东西的代言人。尽管原本可以有理有据地支持特朗普重返推特，马斯克却没有这么做，而是向用户发起了问卷调查。他在推特上发表侮辱性言论、暗含性别歧视的言论和至少一种阴谋论，甚至引发了人们对他言论自由观念的质疑。他以向批评者发贴挑衅为乐。这情有可原（几乎每个在推特上的名人都这么做），但身为推特的老板，行为表现得像推特上的又一个部落勇士似乎不是明智之举。就像对其他人所做的那样，推特可能会接过他绝对自由意志论的、永远唱反调的观点——再把它变得更刺耳、更做作，很无趣。

最麻烦的是，马斯克正在亲身展示推特可以是个多么无聊的消遣。在解释自己为什么致力于让人类成为多行星物种时，他曾对传记作家阿什莉·万斯（Ashlee Vance）说，“就是为了尽可能地延长人类的存在。”唱衰马斯克就太过傲慢了，但如果其目标是拓展人类文明的边界，那推特似乎是比较之前的SpaceX或特斯拉都还要疯狂的“登月项目”。或许他会按自己的设想把推特变成有建设性的公共广场，让它成为说真话、找真相的地方，并且借此重振美国臃肿而不可靠的新闻业。但就目前而言，推特似乎是在浪费马斯克的时间，比对其他人的浪费更严重。■



Will the cap fit?

The West's proposed price cap on Russian oil is no magic weapon

The global energy system is far more flexible than you think

NINE MONTHS after the invasion of Ukraine, oil money continues to fill Vladimir Putin's war chest. Even as the West has imposed sanctions, Russia's crude exports have held up and the Urals oil price remains close to its average in 2014-20. Russia's current-account surplus this year is expected to be \$265bn, second only to China's. But the story is not over yet. On December 5th the European Union will at last implement a plan originally cooked up in May. It will ban seaborne imports of Russian oil. It will also prohibit European firms from insuring, shipping or trading Russian crude anywhere in the world—unless the oil is sold at a price below a cap set by the West.

Ever since the war began in February this year, the West has grappled with a conundrum. How should it cut Russia's fossil-fuel earnings without also reducing the global supply of oil and fuelling inflation that hurts consumers around the world? When Europe first dreamed up its ban, it threatened to deal a serious blow to Russia's oil cashflows. European insurers and shipping firms have long had a vice-like hold on energy markets. Fully 95% of property and indemnity insurance for all oil tankers has been handled by firms from Britain and the EU. This appeared to be a lever with which the West could control the sale of Russian oil globally.

Yet even as the ban was announced a flaw was apparent. If Russian oil fails to make it to market, then global oil prices may spike, hurting Western consumers. Hence America's Treasury department has since devised a cunning plan to water it down: to let European firms continue to offer their services, provided the oil involved is bought at a suppressed price set by the West.

On paper, this looks astute. Setting the price below the market rate Russia receives today would lower its earnings. And as long as the price is above its cost of production (which is thought to be in the region of \$20-44 a barrel), Mr Putin would still have a reason to pump oil. Consumers would get oil at a discount and inflation would be kept in check. Non-aligned countries such as China and India would surely leap at this bargain.

According to hard-headed oilmen, however, life rarely turns out so neatly. There are two uncertainties. One is how Mr Putin responds if European firms really do have a stranglehold and can block his ability to get some oil to market. Russia has already said it will refuse to use tankers that join the oil-cap scheme. It could cut its oil exports, relying on a smaller group of non-Western tankers and insurers, and sending global prices spiralling.

Fear of this could explain why the West has been careful to peg the oil price at a level that is still attractive to Russia. At the time of writing, the level was expected to be established at around \$60 a barrel, which is broadly the current market price for Urals oil. Yet that would mean the embargo-and-price-cap scheme has little bite.

The other uncertainty is how much power the West will ultimately wield over global oil markets. A shortage of non-Western tankers could curb Russian supply over the next couple of months. Some kinds of insurance, for example, against big spills, are hard to find outside the West. Still, countries such as China, India and Indonesia want to avoid participating in Western sanctions and embargoes. They are seeking alternative sources of day-to-day insurance—and, because the ban was announced six months ago, have had time to prepare.

The true balance of power in oil markets will become apparent after December 5th. A violent price spike is possible. But the lesson from this year is that, over time, the global oil system is more adaptable than you

might think. Just as financial sanctions have energised attempts to evade the Western banking system, so the war will lead China, India and others to circumvent the West's energy infrastructure. As weapons, sanctions and embargoes have their limits—and a finite shelf-life. ■



【首文】限价适用吗？

西方对俄罗斯石油限价，但这并非制胜法宝

全球能源系统的灵活性远超人们所想

俄罗斯入侵乌克兰九个月后，石油收入仍在源源不断地补充普京的军费开支。在西方国家的制裁之下，俄罗斯原油出口却依旧坚挺，乌拉尔原油价格保持在2014年至2020年的平均水平附近。预计俄罗斯今年的经常账户盈余将达到2650亿美元，仅次于中国。但故事还没完。12月5日，欧盟最终实施早在5月制定的制裁计划。它将禁止成员国通过海运进口俄罗斯石油，还将禁止欧洲公司在全球任何地方为俄罗斯石油提供保险、运输或做交易——除非俄罗斯石油售价低于西方设定的上限。

自从今年2月俄乌开战以来，西方世界一直陷于两难：该如何打压俄罗斯的化石燃料收入，同时又不会让全球石油供应下降，以致进一步推高通胀，损害世界各地的消费者？欧洲最早谋划禁令时，曾威胁要重创俄罗斯的石油现金流。长期以来，欧洲的保险公司和船运公司牢牢控制着能源市场。全球95%的油轮财产与赔偿保险都是由英国和欧盟的公司处理的。这似乎是西方控制俄罗斯石油全球销售的一根操纵杆。

但宣布禁令的同时，一个软肋也暴露出来。假如俄罗斯石油不能流入市场，全球石油价格就可能飙升，伤害西方消费者。于是，美国财政部后来设计了一个巧妙的方案来弱化这一影响：让欧洲公司继续提供服务，条件是这些石油是以西方设定的限价购入的。

表面上看，这招着实精明。把俄罗斯石油价格压至当前市场价格之下，俄方收益将下降。而只要售价高于生产成本（据信每桶成本在20至44美元之间），普京就仍有理由继续开采石油。消费者能以折扣价获得石油，通胀也能得以控制。中国和印度等采取中立立场的国家肯定会趁低价抢购。

然而，在头脑冷静的石油商看来，现实很少会完全照着剧本走。这里面有两个不确定因素。首先，假如欧洲公司真的能扼住俄罗斯的咽喉，限制它

向市场输送部分石油，普京会作何反应？俄罗斯已表示将拒绝使用加入油价上限计划的油轮。它可能削减石油出口，依赖数量较少的非西方油轮和保险公司，让全球油价飙升。

可能正是出于这方面的担忧，西方一直小心谨慎地把油价定在仍能吸引俄罗斯的水平上。在笔者撰稿之际，预计这一价格水平是在每桶60美元左右，大致相当于当前的乌拉尔原油市场价。但这就意味着禁运和限价方案的威力不大。

另一个不确定性是西方对全球石油市场的影响力到底有多大。非西方国家油轮的短缺可能会在未来两三个月里遏制俄罗斯石油的供应。针对大规模漏油等风险的保险服务很难在西方国家以外的地方找到。但中国、印度和印度尼西亚等国家不想参与西方的制裁和禁运行动。它们正在另觅常规保险的供应商，而且由于禁令是在六个月前宣布的，它们有时间做准备。

石油市场真正的力量对比将在12月5日之后变得清晰。油价可能猛涨。但这一年的教训是，长远来看，全球石油系统的适应性超出人们所想。正如金融制裁会激发人们尝试绕过西方的银行系统，俄乌战争也将导致中国、印度和其他国家规避西方的能源基础设施。作为武器，制裁和禁运的威力有限，而且会过期。 ■



Bartleby

The open questions of hybrid working

A mix of office and home has become the norm for many. There is lots still to figure out

AT FIRST THE question was how quickly people would get back to the office. Then it was whether they would ever return. Almost three years after reports surfaced of an unusual respiratory illness in Wuhan, the legacy of the covid-19 pandemic on employees in America and Europe is becoming clear. The disease has ushered in a profound change in white-collar working patterns. The office is not dead but many professionals have settled into a hybrid arrangement of some office days and some remote days.

Hybrid working has much to recommend it: flexibility for employees, periods of concentration at home, bursts of co-operation in the office. A new paper from Raj Choudhury, Tarun Khanna and Kyle Schirmann of Harvard Business School and Christos Makridis of Columbia Business School describes an experiment in which workers at BRAC, a huge non-profit organisation in Bangladesh, were randomly assigned to three groups, each spending different amounts of time working from home. The intermediate group, who spent between 23% and 40% of their time in the office, performed best on various performance measures.

But a shift of this magnitude is bound to raise thorny issues. In workplaces that have moved to hybrid work, there are still plenty of open questions. One is how to handle the impact of less time in the office for new joiners and younger workers. Research by Natalia Emanuel of the Federal Reserve Bank of New York, Emma Harrington of the University of Iowa and Amanda Pallais of Harvard University shows that software engineers receive more online feedback on their code when the team sits next to each other. The people who get disproportionately more feedback from colleagues when

they are in proximity are young engineers and female ones. These developers were also most likely to quit when the pandemic forced everyone to go remote.

Not every study points in the same direction. In a recent survey of hybrid workers in London, the youngest cohort was more likely than older ones to think that it was easier to put themselves forward for important tasks when working remotely. But according to Nicholas Bloom of Stanford University, making new employees spend more time than others in the office can be a good way of steeping them in company culture. Whatever expectations firms set for the bulk of their hybrid workforce, an extra day of commuting may make sense for newbies.

A second question concerns how strictly to enforce attendance on days when teams are meant to be in the office. An emerging consensus holds that there should be agreed “anchor days” on which people come in; since the idea is to spend time together, as many people as possible should be there. But one person on the team might have moved somewhere godforsaken for the scenery back in 2020; someone else might have asked to stay home to let the plumber in. In practice, therefore, hybrid working still often means a mixture of people on screen and people in the flesh.

“One virtual, all virtual” was an early refrain for these circumstances. At a meeting where some people were in the room and others were working from home, everyone dialled in on their own screens and deafened each other with feedback. But the research by Ms Emanuel and colleagues suggests that moving everything online is harmful. Before the pandemic, having a single colleague in a different building was associated with less feedback. Treating remote workers as second-class citizens may actually make sense on those days when people are expected to be in.

That logic also applies in reverse. One of the great worries about hybrid

working is that it can encourage “proximity bias”, the phenomenon whereby bosses prefer employees with whom they have more face-to-face contact (“Fred may be useless but at least he’s being useless here”). Mr Bloom reckons that this problem can be alleviated if bosses who like the office make sure to work at home occasionally (Fred cannot gain as much of an edge by being seen if the boss isn’t always there to see him).

Other questions abound. How to define performance measures so managers do not spend time fretting about slackers at home? Do you require company-wide anchor days or team-level ones? The era of hybrid working is only just beginning, so it will take time for answers to emerge. But if there is a message from this first full year of hybridity, it is that flexibility does not mean a free-for-all. The elastic week needs some fairly rigid scaffolding. ■



巴托比

关于混合工作的悬而未决的问题

对许多人来说，办公室和家相结合已经成为常态。但还有许多细节需要厘清

起初的问题是人们多快能回到办公室。接着问题成了他们还会不会回来。在武汉爆出一种不寻常的呼吸系统疾病近三年后，新冠肺炎大流行对美国 and 欧洲员工的影响越发清晰。这种疾病给白领的工作模式带来了深刻的变化。办公室并没有消亡，但许多专业人士已经开始习惯了一种混合式的安排：在办公室工作几天，远程工作几天。

混合工作有许多可取之处：员工可以灵活自由地安排工作时间和节奏，在家有大块时间专注地工作，时不时地在办公室里合作有成。哈佛商学院的拉杰·乔杜里（Raj Choudhury）、塔伦·坎纳（Tarun Khanna）和凯尔·希尔曼（Kyle Schirmann）以及哥伦比亚商学院的克里斯特斯·马克里迪斯（Christos Makridis）在一篇新论文中描述了一项实验。在该实验中，孟加拉国一家大型非营利组织BRAC的员工被随机分配到三个组，每个组居家工作的时长不同。居中的那一组花23%到40%的时间在办公室，在各项业绩指标上表现最好。

但是如此巨大的转变必然会引发棘手的问题。在已经转向混合工作的工作场所仍有许多悬而未决的问题。一是如何应对新员工和年轻员工在办公室的时间缩短所造成的影响。纽约联储的娜塔莉娅·伊曼纽尔（Natalia Emanuel）、爱荷华大学的艾玛·哈灵顿（Emma Harrington）和哈佛大学的阿曼达·帕莱（Amanda Pallais）的研究表明，当团队坐在一起时，软件工程师会收到更多关于他们代码的在线反馈。年轻的工程师和女性工程师从近在咫尺的同事那里获得的反馈尤其会增加。当疫情迫使所有人转向远程工作时，这些开发人员也最有可能离职。

并非所有研究都得出了相同的结论。在最近一项对伦敦采用混合工作模式的员工的问卷调查中，最年轻的群体比年长群体更有可能认为，远程工作时自己更容易挺身而出承担重要任务。但是斯坦福大学的尼古拉斯·布鲁

姆（Nicholas Bloom）认为，让新员工比其他人花更多时间在办公室可能是让他们融入公司文化的好方法。无论公司对采取混合模式的大部分员工有何期待，多花一天时间通勤对新人来说可能都是有意义的。

第二个问题是，在团队应该进办公室的日子里该多严格地执行出勤规定。一个正在形成的共识是人们应该商定一个进办公室的“锚定日”；既然初衷是让大家相聚，那么能来的就该都来。团队中的某一个人可能已经为了重回2020年的时光而搬到了一个不毛之地。其他人可能会申请留在家里等水管工上门。因此，在实践中，混合工作模式仍然经常意味着一部分人在屏幕上露脸，一部分人在办公室现身。

“一人虚拟，全员虚拟。”之前在这类情况下人们总会这么说。开会时一些人在办公室里，另一些人居家，结果就是人人都用自己的设备拨打进来，混乱的此起彼伏的声响冲击彼此的耳膜。但是伊曼纽尔及其同事的研究表明，把所有东西都移到线上是有害的。换在疫情前，某一位同事身在另一栋楼意味着反馈减少。在所有人都该在线下出勤的日子里，把远程工作的员工视为二等公民可能还真说得过去。

这个逻辑反过来也适用。对混合工作的最大担忧之一是它会鼓励“邻近偏差”现象，即老板更青睐与他们面对面接触更多的员工（“弗雷德也许是个废物，但起码他是在这里当废物”）。布鲁姆认为，如果让喜欢办公室的老板确保偶尔也在家里工作一下，这个问题就可以得到缓解（如果弗雷德并不总能见得到老板，他在老板眼前晃悠也就不能带给他太多优势）。

还有其他很多未解的问题。该如何定义绩效指标，让管理者不用耗费时间担心有人在家偷懒？是需要制定全公司层面的锚定日还是团队级别的？混合工作的时代才刚刚开始，因此答案的浮现还需要时间。但是，如果说经历了这一整年的混合工作后能得出什么经验的话，那就是灵活安排不意味着为所欲为。弹性的工作周需要一些相当刚性的脚手架来支撑。 ■



AI and Diplomacy

Another game falls to an AI player

This time it is one that involves negotiation and double-dealing

BACKGAMMON WAS an easy win. Chess, harder. Go, harder still. But for some aficionados it is only now that artificial intelligence (AI) can truly say it has joined the game-playing club—for it has proved it can routinely beat humans at Diplomacy.

For those unfamiliar with the game, its board is a map of Europe just before the first world war (except that, for no readily apparent reason, Montenegro is missing). Participants, seven ideally, each take on the role of one of the Great Powers: Austria, England, France, Germany, Italy, Russia and Turkey. Each has armies and navies, and geographically based resources to support them, and can use its forces to capture the territory of neighbours, thus gaining the means to raise more forces while depriving others of the same.

The trick is that, at least at the beginning, players will get nowhere without making agreements to collaborate—yet they are not bound by the game's rules to keep to these agreements. Only when orders for the movement of troops and vessels, which have to be written down, are revealed, does a player discover who really is a friend, or an enemy.

Cicero, a program devised by a group of Mark Zuckerberg's employees who dub themselves the Meta Fundamental AI Research Diplomacy Team, proved an adept pupil. As the team describe in *Science*, when they entered their creation into an online Diplomacy league, in which it played 40 games, it emerged as one of the top 10% of players—and no one rumbled that it was not human.

In all past AI game-playing projects the program has learned by

reinforcement. Playing repeatedly against itself or another version of itself, it acts first at random, then more selectively. Eventually, it learns how to achieve the desired goal. Cicero was taught this way, too. But that was only part of its training. Besides having the reasoning to plan a winning strategy, a successful Diplomacy player must also possess the communicative ability to implement it.

The Meta team's crucial contribution was therefore to augment reinforcement learning with natural-language processing. Large language models, trained on vast amounts of data to predict deleted words, have an uncanny ability to mimic the patterns of real language and say things that humans might. For Cicero, the team started with a pre-trained model with a baseline understanding of language, and fine-tuned this on dialogues from more than 40,000 past games, to teach it Diplomacy-specific patterns of speech.

To play the game, Cicero looks at the board, remembers past moves and makes an educated guess as to what everyone else will want to do next. Then it tries to work out what makes sense for its own move, by choosing different goals, simulating what might happen, and also simulating how all the other players will react to that.

Once it has come up with a move, it must work out what words to say to the others. To that end, the language model spits out possible messages, throws away the bad ideas and anything that is actual gobbledygook, and chooses the ones, appropriate to the recipients concerned, that its experience and algorithms suggest will most persuasively further its agenda.

Cicero, then, can negotiate, convince, co-operate and compete. Seasoned Diplomacy players will, though, want to know something else: has it learned how to stab? Stabbing—saying one thing and doing another (especially, attacking a current ally) is seen by many as Diplomacy's

defining feature. But, though Cicero did, “strategically withhold information from players in gameplay”, it did not actually stab any of its opponents. Perhaps it was this final lack of Machiavellian ruthlessness which explains why it was only in the top 10%, and not victor ludorum. ■



AI与《外交》

人工智能选手又拿下下一个游戏

这一回玩的游戏涉及谈判和耍两面派

玩双陆棋要赢很容易。象棋要难些。围棋就更难了。但是对于一些发烧友来说，直到现在人工智能（AI）才算真正跻身游戏俱乐部——因为它已经证明自己在玩《外交》（Diplomacy）时能屡屡击败人类。

在此先向那些不熟悉这款游戏的人说明一下它的玩法：它的棋盘是一幅一战前的欧洲地图（只不过黑山不见了，原因不得而知）。参与者最好有七个，各自扮演以下大国中的一个：奥地利、英国、法国、德国、意大利、俄罗斯和土耳其。每个国家都有陆军和海军，以及能够支持军队的基于地理位置的资源，它们可以动用军队占领邻国的领土，从而有资本扩充自己的军队，同时令其他国家丧失资源和兵力。

如果不达成合作协议，玩家们将一无所获，至少在一开始是如此；但游戏规则又没有规定他们必须遵守这些协议，这就是这个游戏烧脑的地方。唯有当必须以文字写下来的调遣军队和船只的命令揭晓时，玩家才能发现谁是真正的朋友，谁是敌人。

“西塞罗”（Cicero）在学习玩这个游戏时上手很快。这是马克·扎克伯格手下的一群员工设计出来的一个程序，他们自称“Meta基础人工智能研究外交团队”（Meta Fundamental AI Research Diplomacy Team）。据该团队在《科学》杂志上的描述，他们让西塞罗加入了一个《外交》线上游戏联盟，它在里面玩了40场游戏，最后荣登排名前10%的玩家之列——没有一个人抱怨它不是个真人。

在之前所有的人工智能游戏项目中，程序都是通过强化来学习的。它与自己或另一个版本的自己反复对垒，一开始的行动很随机，后来变得更有选择性，最终学会了如何达到期望的目标。西塞罗也是这样被教导的。但这只是训练的一部分。除了要有制定出制胜策略的推理能力，一个成功的

《外交》玩家还必须具备实施策略的沟通能力。

因此，Meta团队的重要贡献是使用自然语言处理来增强强化学习。运用大量数据训练出来的大型语言模型可以预测被删除的单词，有着模仿真实语言模式的惊人本领，能说出人类可能会说出的话。该团队先将一个对语言有着基线理解的预先训练过的模型用于西塞罗，再利用过去40,000多场游戏中的对话对模型做微调，让它学会《外交》特有的言语模式。

玩这个游戏时，西塞罗要观察棋盘，记住之前的棋步，并根据经验猜测其他人下一步想做什么。然后它会选择不同的目标、模拟可能发生的情况以及其他所有玩家对此会作何反应，试图琢磨出自己怎么走最合适。

一旦想出了下一步，它又得琢磨出该对其他玩家说些什么话。为此，语言模型会生成一堆可能用得着的信息，排除掉坏主意和任何根本就是连篇废话的东西，选择那些适合发送给相关玩家的信息，而且经验和算法显示这些信息最能让它有说服力地推进自己的计划。

因此，西塞罗能够谈判、说服、合作和竞争。不过老道的《外交》玩家还是会好奇另外一件事：它学会两面三刀了吗？在很多人看来，说一套做一套（尤其是攻击当前的盟友）是《外交》这个游戏的最典型特征。但是，尽管西塞罗确实“在游戏中有策略地对其他玩家隐瞒了信息”，它实际上并没有背刺过任何对手。到头来它还是缺了点马基雅维利式的冷酷无情。也许这能解释为什么它只挤进了前10%，而没成为大赢家。■



The China Dilemma

Multinational firms are finding it hard to let go of China

Should companies divest, decouple—or double-down?

FEW JOBS are guaranteed to turn hair grey faster than running operations for a multinational business in China. Diplomatic spats and consumer boycotts are hazards of the job. A zero-covid policy that causes intermittent local lockdowns, such as the one that recently began in the southern city of Guangzhou, has disrupted supply chains and made the country inhospitable to foreign managers. A fractious workforce is adding to the woes. On November 23rd a riot erupted over pay and working conditions at the main factory that makes Apple's iPhones in China. In a survey by the European Chamber of Commerce in China, 60% of members reported that the business environment has become more challenging.

One solution for international firms is to rely less on China for manufacturing. Some have been diversifying supply chains away from the country. Companies including Apple and Hasbro, a toymaker, have spread production to Vietnam and India, where wages are lower and the operating environment is less likely to induce a migraine. Bangladesh and Malaysia are becoming more attractive to clothes-makers. But for many multinationals China is more than just a cheap place to make things, and therein lies a less tractable problem.

China's increasingly affluent 1.4bn inhabitants now account for a quarter of global sales of clothes, nearly a third of jewellery and handbags, and around two-fifths of cars, plus a sizeable share of packaged food, beauty products, pharmaceuticals, electronics and more (see chart). Its gigantic manufacturing base makes it the world's largest market for machine tools and chemicals, and its construction industry has been the largest buyer of building equipment for years.

Although 2,800 exhibitors from 145 countries recently turned up to flog their wares at the China International Import Expo in Shanghai, in aggregate global business's exposure to China looks modest. For all listed American companies, China accounts for just 4% of sales, according to Morgan Stanley, an investment bank. For Japanese and European firms the figures are 6% and 8% respectively.

Yet there is a cohort of firms for whom China has been far more important. The Economist has analysed multinational firms from America, Europe and Japan that disclose sales in the Middle Kingdom, using data from Bloomberg. The 200 biggest of these earned \$700bn there last year, or 13% of their global sales, up from \$368bn, or 9% of sales, five years ago. Of the \$700bn, 30% was generated by technology-hardware firms, 26% by consumer-facing businesses, and 22% by industrial companies, with carmakers and commodity businesses also important. Some 13 multinationals report over \$10bn of revenue a year in China including Apple, BMW, Intel, Siemens, Tesla and Walmart.

An unlucky subset of multinationals operating in China has already found itself caught in the geopolitical crossfire. On our list 22 companies are in the semiconductor business. Many will find their sales pummelled by America's ban on selling advanced chips and chipmaking equipment to China. When on average 30% of revenues come from China that will be a painful adjustment.

With relations between China and the West on shaky grounds, notably over the issue of Taiwan, even multinationals that operate outside so-called strategic sectors are hatching contingency plans for a world without access to the country. For many their situation is worsened by growing competition from local firms.

Premium carmakers such as BMW and Mercedes-Benz continue to grow

robustly in China, but sales from mid-range ones like Volkswagen (VW) and General Motors are shrinking as homegrown rivals including Chery and BYD expand rapidly. Sales for Nike, a sportswear brand, are also stalling as Li-Ning and Anta, two local competitors, gain ground. Sales have similarly stalled for AmorePacific, a Korean beauty firm, as competition stiffens from mid-range Chinese brands such as Winona. Foreign makers of construction equipment including Caterpillar and Hitachi have been losing sales thanks to a combination of increased competition and a construction downturn. In The Economist's analysis of 20 industries with a sizeable multinational presence, foreign companies have lost share in 14 over the past three years.

Two forces are at work. The first, especially important for consumer goods, is that foreign brands are losing their cachet. Knowing how to design products and build demand has given an important competitive edge to multinational consumer-goods firms, notes Wern-Yuen Tan, head of the Asia-Pacific region for PepsiCo, a food and drink firm. By watching and learning, not to mention poaching talent, local businesses have begun to bridge that gap.

The Chinese consumer has been changing, too. Many now prefer products that incorporate distinctive Chinese cultural imagery, a phenomenon known as guochao (literally "national trend"). What started with a China-themed lineup by Li-Ning at New York Fashion Week in 2018 has spread to everything from make-up to soup.

Foreign brands have had mixed success incorporating Chinese culture into their products. Osmanthus-flavoured Pepsi was a hit. Less popular was a sneaker range from Nike displaying two Chinese characters that individually translated as "becoming wealthy" and "fortune" but when put together meant "getting fat". Nike and other foreign firms have also dented their positions by expressing concern over the country's brutal treatment of its Uyghur minority in Xinjiang.

The second reason for the troubles of multinationals, particularly in heavy industries, has been a shrinking technological advantage. The typical strategy for Chinese firms has been first to disrupt the inexpensive, commoditised end of a market and gradually move up into more sophisticated offerings as expertise builds, notes Weiwen Han, China head of Bain, a consultancy. That helps explain why carmakers like VW are struggling, and why foreign firms in industries from construction equipment to machine tools are being pushed into the premium market.

This should come as no surprise. When foreign firms first sought access to China, beginning in the 1980s, entering joint ventures with Chinese firms was a condition in industries like carmaking and machinery. It was a Faustian bargain, with domestic firms gradually absorbing foreign engineering expertise. The fact that China is now loosening joint-venture requirements shows that it no longer fears the technological edge of outsiders.

The growing challenge from locals is putting many multinationals in a sticky situation: maintaining competitiveness in China demands increased investment even as the geopolitical risks are mounting. For now most multinationals have time on their hands. Of the list of 200 companies we examined, 144 have still grown in China over the past three years.

| *Movers and makers*

Over time the situation will become more vexing. China has lacked the expertise to manufacture its own large commercial jets, with Boeing and Airbus controlling the industry. At an airshow on November 8th COMAC, a local manufacturer, debuted its long-awaited C919, a short-haul passenger aircraft, and will soon start deliveries to Chinese carriers. Western firms like LVMH and Hermès have for years dominated the flashiest end of fashion in China, but homegrown competitors like Shang Xia are gaining momentum. Such rivalries will force foreign firms to confront the awkward

question of their long-term future in the country. They will need to choose one of three paths—divest, decouple or double-down.

Divestment is an option for some. Carrefour, a French supermarket chain, sold 80% of its China business to Suning.com, a local retailer, in 2019 after more than two decades in the country. Gap, an American clothing retailer, announced on November 8th that it would offload its Chinese business to Baozun, a local e-commerce company. Throwing in the towel while the business is still worth something will probably be the favoured option for firms that have lost their edge over domestic rivals and can afford to live without China.

Decoupling is a second possibility. Yum! Brands, the owner of KFC and other fast-food franchises, split out its China business in 2016 to allow the unit to adapt more easily to local conditions. The following year McDonald's did the same. The strategy comes with the added advantage of simplifying any divorce proceedings initiated by geopolitical souring while for now allowing the local business access to parent company brands and other intellectual property. This route however will only be viable in cases where China can be operated as a self-contained unit; it is off the cards for firms like Boeing or LVMH that rely on manufacturing abroad.

Third, consider doubling-down. Siemens, a German industrial conglomerate, recently revealed that it is ramping up investment and shifting a significant share of research and development to China in order to “beat the local champions”, according to Roland Busch, the company's boss. On October 13th VW announced it would invest €2.4bn (\$2.5bn) to establish an autonomous-driving joint venture with Horizon Robotics, a Chinese firm.

Such hard-to-reverse commitments will be most common in industries where keeping a strong position in China is critical for global

competitiveness. Carmakers fear that giving ground to local champions, many of whom are already at the cutting edge of electric vehicles and software, would give them a launch pad to enter other big markets. If relations between China and the West remain cordial, doubling-down may pay-off. If they worsen, things may quickly unravel for the geopolitical gamblers of global business. ■



在华困境

跨国公司很难放弃中国

它们应该剥离、脱钩，还是加倍押注？【深度】

要说什么样的工作能让人很快就愁白了头，没什么能比得上在中国管理跨国公司。外交争端和消费者抵制的风险与这项工作形影相伴。新冠清零政策时不时导致区域性封锁（例如近期在南方城市广州开始的情况），扰乱了供应链，让在中国工作的外国经理人难以安居乐业。员工们情绪烦躁，难以管理，更是加剧了困境。11月23日，中国生产iPhone的主要工厂因工资和工作条件问题爆发骚乱。在中国欧盟商会（European Chamber of Commerce in China）的一项调查中，60%的会员企业表示中国的营商环境挑战加大。

跨国公司解决问题的一个方式是减少对中国制造的依赖。一些公司已经在将供应链向中国以外转移以实现多元化。包括苹果和玩具制造商孩之宝（Hasbro）在内的公司已将生产转移到越南和印度，那些国家工资水平较低，而且经营环境不太会让人头痛。孟加拉国和马来西亚对服装制造商的吸引力越来越大。但对于许多跨国公司而言，中国不只是一个制造成本低廉的所在。这就有了一个不太容易处理的问题。

中国日益富裕的14亿人口如今消费了全球售出服装的四分之一、珠宝箱包的近三分之一、汽车的约五分之二，在包装食品、美容产品、药品、电子产品等商品的消费中也占据相当大的份额（见图表）。中国是庞大的全球制造基地，自然也就成为全球最大的机床和化学品市场，其建筑业多年来一直是建筑设备的最大买家。

尽管有来自145个国家的2800家参展商参加了最近在上海举办的中国国际进口博览会，但总体而言，全球企业对中国市场的依赖程度似乎并不高。根据投行摩根士丹利的数据，中国市场仅占有所有美国上市公司总销售额的4%。在日本和欧洲上市公司总销售额中的占比分别为6%和8%。

然而对有些公司来说，中国的重要性要大得多。本刊基于彭博的数据，分析了那些披露了在华销售额的美国、欧洲和日本跨国公司。其中前200大公司去年在中国的总收入达到7000亿美元，占它们全球销售额的13%，而五年前的数字分别是3680亿美元和9%。在这7000亿美元中，30%来自科技硬件公司，26%来自消费品公司，22%来自工业企业，汽车制造商和大宗商品企业也占了相当比例。包括苹果、宝马、英特尔、西门子、特斯拉和沃尔玛在内的13家跨国公司报告称在中国的年收入超过100亿美元。

在中国经营的跨国公司中有一部分不太走运，已经身陷地缘政治冲突的困局之中。在我们的名单上有22家半导体公司。其中有许多会看到，美国对华禁售先进芯片和芯片设备的措施将沉重打击销售。当收益有平均30%来自中国之时，调整将很痛苦。

由于中国和西方关系不稳，特别是在台湾问题上，即使不在所谓战略性产业里的跨国公司也在制定应急计划，为将来无法进入中国市场未雨绸缪。许多公司遭遇来自中国本土企业日益激烈的竞争，让它们的处境更加艰难。

宝马和梅赛德斯-奔驰等高端汽车制造商在中国继续保持强劲增长，但随着奇瑞和比亚迪等本土竞争对手迅速扩张，大众和通用汽车等中档汽车制造商的销量正在萎缩。运动服装品牌耐克面对两个本土对手李宁和安踏攻城略地，销售停滞不前。由于来自薇诺娜等中档中国品牌的竞争加剧，韩国美妆公司爱茉莉太平洋（AmorePacific）的销售也同样失速。因为竞争加剧和建筑行业低迷，包括卡特彼勒和日立在内的外国建筑设备制造商的销售额也一直在下跌。根据本刊对跨国公司数量较多的20个行业的分析，在过去三年中，有14个行业中的跨国公司录得市场份额下滑。

导致这种情况有两方面的原因。首先，外国品牌正在失去光环，消费品品牌尤其如此。食品和饮料公司百事可乐的亚太区负责人陈文渊指出，消费品跨国公司懂得如何设计产品和建立需求，这让它们享有重要的竞争优势。但本土企业通过观察和学习（更别提还有挖墙脚）已经开始弥合这一差距。

中国的消费者也在发生变化。许多人现在更喜欢融入了独特中国文化意象的产品，这种现象被称为国潮。自从2018年李宁在纽约时装周上推出中国主题系列时装开始，国潮风已经吹到了从化妆品到汤品的各个领域。

外国品牌也尝试将中国文化融入自己的产品中，但成效不一。桂花口味的百事可乐大获成功。耐克推出的一款运动鞋就没那么受欢迎了，这款鞋在鞋跟后面各有一个“发”字和倒写的“福”字，但合在一起就成了“发福”。另外，耐克等外国跨国公司对新疆维吾尔少数民族不人道的待遇表示关注后，市场地位也受到影响。

跨国公司遭遇困境的第二个原因是它们的技术优势不断缩小，尤其是重工业跨国公司。咨询公司贝恩的大中华区负责人韩微文指出，中国企业的典型策略是先颠覆廉价的同质化市场，然后随着专业知识不断累积，逐渐转向更复杂的产品。这有助于解释为什么像大众这样的汽车制造商举步维艰，以及为什么从建筑设备到机床等行业的外国公司正被挤到高端市场。

这种局面应该不足为奇。上世纪80年代外国公司开始寻求打入中国市场时，与中国公司建立合资企业是进入汽车制造和机械等行业的条件。这种浮士德式交易让国内公司逐渐吸收了外国的工程专业知识。中国现在正在放宽合资要求，这表明它不再担心外来企业的技术优势。

来自本土企业的挑战越来越多，许多跨国公司陷入了棘手的境地：要在中国市场保持竞争力就要增加投资，而此时地缘政治风险又在不断增加。目前，大多数跨国公司都还有时间应对。在我们分析的200家公司中，有144家的中国业务在过去三年中仍有增长。

| 出走与坚守

随着时间的推移，它们会更伤脑筋。中国一直缺乏自己制造大型商用飞机的专业知识，因为波音和空中客车垄断着这个行业。11月8日，本土制造商中国商飞在一个航展上推出了人们期待已久的短途客机C919，并将很快开始向中国的航空公司交付飞机。LVMH和爱马仕等西方公司多年来一直主导着中国时尚业的最高端市场，但像上下这样的本土竞争对手正在发展

壮大。这种竞争将迫使外国公司尴尬地面对未来如何在中国长期发展的问题。它们将需要从三条路中择一而行：剥离、脱钩或加倍押注。

有些公司可以选择剥离业务。法国连锁超市家乐福在中国经营了二十多年后，于2019年将其80%的中国业务卖给了本土零售商苏宁易购。美国服装零售商Gap于11月8日宣布，将把中国业务出售给本土电子商务公司宝尊。对于那些和本土竞争对手相比已经失去优势、并且没有中国业务也能生存下去的公司，在这部分业务还值些钱的情况下选择放弃可能是首选。

第二种可能性是脱钩。旗下拥有肯德基等快餐连锁的百胜餐饮集团（Yum! Brands）于2016年拆分了中国业务，以便这部分业务更容易适应本土环境。次年，麦当劳也做了同样的拆分。这个策略有一个额外的好处，就是能简化由地缘政治恶化引发的任何“离婚”程序，同时还能让本土业务暂且继续使用母公司的品牌和其他知识产权。然而要走这条路，中国这块业务必须能完全独立运作，而对于波音或LVMH这样依赖海外制造的公司来说，这是不可能的。

第三条路是加大投资。德国工业企业集团西门子最近透露它正在加大在华投资，并将把很大一部分研发逐步转移到中国。用老板博乐仁（Roland Busch）的话说，这是为了“打败本土龙头”。10月13日，大众宣布将投资24亿欧元（25亿美元）与中国公司地平线成立一家自动驾驶合资企业。

这类承诺难以回头，它会最常出现在那些需要在中国保持强势地位才能保证全球竞争力的行业中。汽车制造商担心，如果把中国市场拱手让给很多已经在电动汽车和软件方面处于领先的本土冠军企业，就会让它们有了进入其他大市场的跳板。如果中国和西方的关系保持友好和睦，加倍下注中国市场可能会有回报。如果关系恶化，对全球商业的地缘政治赌徒来说，所有努力可能很快就会付之东流。■



The Economist Film

Why are blackholes important? Part 1

Singularities are probably the most mysterious thing in physics.



经济学人视频

黑洞为何重要？（上）

奇点可能是物理学中最神秘莫测的东西。



Economic thought

A fascinating, readable biography of Friedrich Hayek

Bruce Caldwell and Hansjoerg Klausinger puncture some long-standing myths about the Austrian economist

Hayek. By Bruce Caldwell and Hansjoerg Klausinger. University of Chicago Press; 824 pages; \$50 and £35

ROBERT SKIDELSKY'S three-volume biography of John Maynard Keynes achieved something few histories of economic thought can do: it was well written, packed with interesting detail and offered enough—but not too much—theory. Now Keynes's great rival, Friedrich Hayek, is the subject of a biography comparable to Lord Skidelsky's. It is certainly on a similar scale. The first volume is more than 800 pages, and a second is on the way. Bruce Caldwell's and Hansjoerg Klausinger's work also has the makings of something just as good.

Keynes and Hayek had radically different outlooks on economics.

"Maynard", as he was known, argued that when a recession loomed, people and the government ought to be encouraged to spend, giving the economy some oomph. "Fritz", in books, newspaper articles and his teaching, was the most dogmatic representative of the opposite view. He thought that Keynesian ideas represented "an extremely dangerous popular delusion" and argued that his counterpart's solutions would not only fail to solve economic problems, but would make them worse.

The rivalry was often heated. Keynes described one of Hayek's efforts as "one of the most frightful muddles I have ever read". Hayek, for his part, suggested Keynes "knew very little economics". (In 2010 their mutual antipathy was immortalised in "Fear the Boom and Bust", a comedy rap battle on YouTube.)

Messrs Caldwell and Klausinger are not interested in adjudicating which of Keynes and Hayek was ultimately right. They are more interested in Hayek the man. It turns out that, despite their professional differences, he and Keynes shared many traits. Both were born into respectable families. Both were too clever for school and so got bored. Both liked holidaying in Cornwall. Both, in their economic theorising, used little mathematics. And, in their personal interactions, there was tremendous mutual respect, even if not always warmth. Keynes arranged for Hayek to spend time with him at King's College, Cambridge, during the second world war.

The book offers wonderful descriptions of the intellectual circles in which Hayek moved. After fighting in the first world war—though he saw little action—he fell under the spell of Ludwig von Mises, a fellow Austrian economist. Over time he became more and more convinced of the futility of state intervention. Hayek moved to Britain in 1931, and events there reinforced his belief that governments were clueless. Stopping in Paris en route to London, he learned that Britain had gone off the gold standard “and 30% was off the magnificent annual salary of £1,000 to which I had been looking forward”.

Governments, he believed, could not know better than millions of individuals when it came to distributing resources. Published in 1944, “The Road to Serfdom” argued that state intervention often produced the need for further state intervention and, with it, raised the chances of fascism. The book was a sensation in America, having been condensed in Reader's Digest. Yet the German translation was banned in early post-war East Germany, on the insistence of the Russians, one of the four occupying powers, who did not like its anti-state message. Incidents such as these solidified in Hayek's mind the idea that his work mattered.

The book punctures some long-standing myths about Hayek. He did not, as many of his acolytes believe, predict the Depression. The Austrian Institute

for Business Cycle Research, of which Hayek was director between 1927 and 1931, did not produce its own forecasts of the American economy; and indeed Hayek was sceptical of forecasting in general. The story that Keynes and Hayek once did air-raid duty together at King's also, unfortunately, appears to be untrue.

Yet the book does in large part confirm the popular notion that Hayek was a rather strange, and not always very nice, man. For someone who believed so passionately in free markets, he seemed obsessed with class and despised America for its vulgarity when he visited in the early 1920s. He joked that he had never seen the inside of his own kitchen, leaving such tasks to his wife, Hella. He concocted an elaborate scheme, involving moving to America, to divorce Hella and be with someone else.

The second volume will cover the period after which Hayek moved to America, his association with the "Chicago school" of economics, his growing influence on the political right and the hardening of his pro-market views as he aged. That there is still so much to learn about Hayek hints at the biggest problem with this biography: its size. The prose is jargon-free and elegant, making it easy enough for the non-specialist to understand. But it would still require a commitment on a Hayekian scale to try to read it all. Perhaps, then, following what Lord Skidelsky did in 2003, the authors might consider condensing their work into a single, smaller book. Their biography deserves a wide audience. ■



经济思想

一本精彩易读的哈耶克传记

布鲁斯·考德威尔和汉斯约格·克劳辛格打破了有关这位奥地利经济学家的一些长久误传【《哈耶克传》书评】

《哈耶克传》，布鲁斯·考德威尔与汉斯约格·克劳辛格著。芝加哥大学出版社，824页，50美元/35英镑。

罗伯特·斯基德尔斯基（Robert Skidelsky）撰写的三卷本凯恩斯传记取得了经济思想史著述少见的成就：文笔好，充满有趣的细节，理论的丰富程度恰到好处。现在，凯恩斯的著名论敌哈耶克有了可与之媲美的传记。当然，也是一样的大部头。第一卷就有800多页，第二卷也即将出版。布鲁斯·考德威尔（Bruce Caldwell）和汉斯约格·克劳辛格（Hansjoerg Klausinger）合著的这部作品同样具备一些优秀特质。

凯恩斯和哈耶克的经济思想截然不同。“梅纳德”（很多人这么叫他）认为，当经济衰退逼近，应鼓励民众消费及政府支出，给经济增添一些活力。而从“弗里茨”发表的著述、报纸文章以及教学中可以看出，他是相反观点的最固执代表。他认为凯恩斯主义思想反映了“一种极其危险的大众妄想”，并表示凯恩斯提出的解决方案不但无法解决经济问题，还会加重问题。

两人的争执往往充满火药味。凯恩斯说哈耶克写的一本书是“我读过最可怕的胡说八道之一”。哈耶克则暗示凯恩斯“基本不懂经济学”。2010年，一则搞笑说唱视频《哈耶克大战凯恩斯》（Fear the Boom and Bust）在YouTube上发布，他们互相嫌弃的模样就此深入人心。

考德威尔和克劳辛格无意判定最终的胜者是凯恩斯还是哈耶克，他们更感兴趣的是哈耶克本人。事实上，两位经济学家虽然专业观点迥异，但在个人特质方面却有很多共通点。两人都出生在体面的家庭，都聪明绝顶而觉得上学太无聊，也都喜欢到康沃尔度假。两人的经济理论都很少运用数学

论证。而且，两人在私下交往中都极为尊重对方，尽管不总是很热络。二战期间，凯恩斯曾安排哈耶克到剑桥大学国王学院共处了一段时日。

这本书对哈耶克身处的流动的知识分子圈子做了非常精彩的描述。在一战中服役归来后（尽管没怎么上战场），他受到了同为奥地利经济学家的路德维希·冯·米塞斯（Ludwig von Mises）的影响。逐渐地，他越发认为政府干预是徒劳的。哈耶克于1931年移居英国，那里发生的事件更令他确信政府毫无头绪。他在前往伦敦的途中在巴黎逗留，得知英国放弃了金本位制，“我满心期待的1000英镑的丰厚年薪就这样打了七折”。

他认为，在分配资源的问题上，政府不可能比千百万个人更清楚。1944年出版的《通往奴役之路》认为，政府一旦插手干预往往就不得不做进一步的干预，这就增加了滑向法西斯主义的风险。这本书在美国引起轰动，被《读者文摘》摘录推介。但它的德文译本在战后早期的东德被禁，因为四大占领国之一苏联不喜欢其中传递的反政府信息而坚持不放行。这类事件让哈耶克越发坚信自己的著作举足轻重。

这本书戳破了一些关于哈耶克的流传已久的佳话。他并没有像许多追随者认为的那样预测了大萧条。哈耶克在1927年至1931年间担任奥地利商业周期研究所（Austrian Institute for Business Cycle Research）所长，该机构并没有对美国经济前景做出预测。而且事实上，哈耶克对于预测总体上持怀疑态度。遗憾的是，有关凯恩斯和哈耶克曾经在国王学院一起值守防空袭的故事似乎也不是真的。

但这本书确实在很大程度上印证了一个普遍说法：哈耶克是个相当怪的人，也不总是很友善。一个如此热衷于自由市场的人却似乎又对阶级有执念，上世纪20年代初他到访美国时嫌那里粗鄙庸俗。他曾开玩笑说从没看过自家厨房什么样，因为这类家务都是妻子赫拉的事。他精心谋划了一个方案，好和赫拉离婚与另一个人在一起，包括搬去美国。

传记的第二卷将讲述哈耶克即将移居美国的那段日子、他与“芝加哥学派”的关系、他对政治右翼日益增长的影响力以及随着他年事渐高而愈加强硬

的亲市场观点。关于哈耶克还有这么多事情可讲，这也就透露出这本传记最大的问题：太厚了。它文笔优雅，不带行话，非专业人士也能轻松看懂。但是，要想读完整本书，还是得有点哈耶克的那种固执坚持才行。那么，两位作者或许可以考虑效仿斯基德爾斯基在2003年的做法，把这两大卷浓缩成一本薄一点的书。他们写的这则传记值得广为传阅。 ■



Biocement

Adding bacteria can make concrete greener

They offer ways to produce cement without releasing carbon dioxide

CONCRETE IS ONE of the world's most important materials. But making the cement that binds it generates about 8% of anthropogenic carbon-dioxide emissions.

This is not just because of the heat involved. That could, in principle, be supplied in environmentally friendly ways. It is, rather, embedded in the very chemistry of the process. The heat is applied to limestone, to break up its principal constituent, calcium carbonate, into calcium oxide (cement's crucial ingredient) and CO₂.

In a warming world, this CO₂ should be disposed of in a manner which keeps it out of the atmosphere. That is tricky. Better, then, not to generate it in the first place, by remodelling the way the aggregates that are concrete's other ingredient are bound together. Intriguingly, this may be an area where microbes can come to the rescue.

One proposal, literally as well as metaphorically green, is to recruit the services of chlorophyll-laden, photosynthesising organisms called cyanobacteria. That has allowed Prometheus Materials, a firm in Colorado, to develop a cement-making process in which the energy comes not from heat but light—something easily generated from electricity that has, in turn, been provided by renewable sources. Moreover, and perhaps more importantly, photosynthesis subtracts CO₂ from the atmosphere rather than adding it.

| *Grow-your-own concrete*

Prometheus raises its bacteria in water-filled “bioreactors” surrounded by

light-emitting diodes, to allow the bugs to photosynthesise. The water contains inorganic nutrients the bacteria need, and is perfused by streams of air bubbles which provide the CO₂. It also has calcium ions dissolved in it—for the purpose of the exercise is to encourage the bacteria to generate from the ingredients provided crystals of calcium carbonate a few microns across—a process called biomineralisation.

The number of bacteria in the bioreactors would double every four to six hours if permitted to do so. Instead, quantities of them are transferred regularly to another tank. Here, they are plied with a proprietary stimulant that accelerates biomineralisation and then allowed to sit for an hour or so to mature. When the crystal-rich gloop that results is mixed with an aggregate, the product is “bioconcrete”.

Bioconcrete actually comes in many varieties, depending on the aggregate employed. For the moment, Prometheus is pinning its hopes on mixing the gloop with sand, together with a so-called hydrogel (think jelly desserts for children’s parties, only more industrial), which further helps to bind the sand grains together.

To reduce the space between the grains in the mixture, and thereby strengthen the resulting material, the company first pours the mix into casts that will shape it into breeze blocks, and then uses machinery which compresses and, for about ten seconds, “vibrates the heck out of it”, says Loren Burnett, Prometheus’s boss. The resulting blocks then take about eight days to cure, compared with 28 days for conventionally produced breeze blocks.

Prometheus says making concrete this way emits a tenth of the CO₂ generated by conventional concrete-making. Mr Burnett hopes that will permit the firm to charge a “green premium”—because one thing which the new blocks are not, is cheaper than the conventional variety. He will not,

though, be relying on the construction industry's goodwill for this to happen. Many jurisdictions, including the states of California, Oregon and Washington, are bringing forward regulations that will favour "reduced-carbon" concrete.

How much the premium will need to be to permit a profit is not yet clear, but it should be once Prometheus has shifted production from its laboratory to a pilot manufacturing facility nearby—a move it expects to complete early next year. That said, the firm does hope to bring costs down eventually to a point where it competes with conventional cement-makers on price as well.

One unknown is how permeable to water the new material will prove. But the stuff is certainly strong. Recent batches have withstood pressures of 380kg per square centimetre—more than some conventional concretes can tolerate. Sales of breeze blocks, and also of bricks for sound barriers to dampen traffic noise (an application based on the belief that the hydrogel will dissipate sound better than conventional concrete) should start early next year. Bringing precast bridge segments to market will take a bit longer, as more rigorous certification is involved.

Prometheus says its new plant will be able to turn out nearly 21,000 breeze blocks a month. But, because shipping heavy products long distances is expensive, it is also working on a process that air-dries both the bacteria and the crystals. The idea, says Mr Burnett, is to produce a "just-add-water" biocement mixture that would be lighter than a conventional cement mix, and could thus be shipped more cheaply.

| *Building on organic growth*

Another biocement firm, Biomason, of Research Triangle Park in North Carolina, uses a similar approach, except that its bacteria, *Sporosarcina pasteurii*, do not photosynthesise, so have to be fed organic nutrients, in

the form of sugar and amino acids, as well as inorganic ones. According to Ginger Krieg Dosier, the firm's boss, the result is better than conventional cement at binding fine particles together. This lets Biomason substitute things like mine tailings for part of the sand that would otherwise be used. Biomason's first products are wall and floor tiles branded "Biolith".

Applications for biocement extend beyond conventional construction, too. America's Department of Defence, for one, has shown interest. Its aim is to be able to build things in remote areas without having to hump in cement and other materials. That would be doubly valuable if the territory through which the humping would otherwise be happening were hostile. Indeed, it was the defence department that catalysed the formation of Prometheus, by awarding the team at the University of Colorado which later founded the firm a grant of \$1.8m back in 2017.

The department is also, in the guise of the Defence Advanced Research Projects Agency (DARPA) and the Air Force Research Laboratory, collaborating with Biomason to develop biocement sprays that can turn sand or loose soil into runways. Michael Dosier, Biomason's chief technologist (and the boss's husband), says the hardening involved could require less than 72 hours.

Even wilder uses are on the cards. In a talk given in August to DARPA Forward, a technology conference in Fort Collins, Colorado, Kathleen Hicks, America's deputy secretary of defence, outlined a goal that is literally out of this world: an ability to spray a bacterial liquid on lunar or Martian regolith, in order to "grow a landing pad".

Back on Earth, biocements are already being used to consolidate loose ground for reasons other than runway-making. Some concocted in Singapore by researchers at Nanyang Technological University (NTU) are intended to slow coastal erosion.

To do this, NTU's civil and environmental engineering department is formulating recipes that mix seawater, calcium chloride, urea and an enzyme from soyabeans. For some batches, the calcium chloride and urea have been successfully substituted, respectively, by carbide sludge, an industrial waste, and human urine.

NTU's biocements are conveniently watery and, once set in concrete as it were, colourless. This means, says Chu Jian, the department's chairman, that, "you just need to pour the solution on top of the beach". Singapore's National Parks Board is testing NTU's biocements at two beaches that are being worn away by the waves—one fringing the island state's south coast, the other in a group of offshore islets.

| *Filling in the cracks*

Another ingenious bacterial concoction intended for the construction industry is produced by Basilisk, a firm in the Netherlands. In 2017 it launched a product that heals cracks in concrete.

Basilisk Healing Agent consists of tiny pellets that hold dried spores from a range of bacteria belonging to the genera *Planococcus*, *Bacillus* and *Sporosarcina*, together with nutrients including polylactic acid. Construction workers pour the pellets into conventional cement when mixing it with water and aggregate. The high alkalinity of uncured cement stops the moisture activating the spores. That alkalinity drops, however, as the concrete cures. This means that, if a crack appears and water gets in, the spores in the embedded pellets are primed to spring into action and generate calcium carbonate. This fills in fissures up to a millimetre across, nipping potentially dangerous cracks in the bud.

Not only does that lower maintenance costs, it also means the concrete concerned need contain less reinforcing steel, since the quantity of such "rebar" used in conventional concrete anticipates the extra strength which

will be needed as cracks inevitably form. A cubic metre of typical concrete thus requires 100-120kg of rebar, at a cost of around a dollar a kilogram. According to Bart van der Woerd, Basilisk's boss, adding 5kg of Basilisk's pellets can halve that requirement for some projects, and will set you back only €37 (\$37).

Not only does that save money, it also saves CO₂ emissions—because making steel from iron ore is another process that releases this gas for fundamental-chemical rather than mere energy-generating reasons. (The ore is iron oxide, and the oxygen is plucked from this to leave metallic iron by its reaction with the carbon in coke.) Less steel equals less CO₂. Sometimes then, and luckily, it is the road to heaven, not that to hell, which is paved with good intentions. ■



生物水泥

加入细菌可以让混凝土“变绿”

这提供了零排放的水泥生产工艺【新知】

混凝土是世界上最重要的材料之一。把混凝土成分接合在一起要用到水泥，而生产水泥带来了约8%的人为碳排放。

这不仅是因为生产水泥要消耗热能。原则上，热能的供应可以采取对环境友好的方式。更主要的原因是水泥生产中的化学反应。热能被用来加热石灰石，以将其主要成分碳酸钙分解为氧化钙（水泥的关键成分）和二氧化碳。

在全球变暖的大背景下，处理这些二氧化碳时应该避免让它们进入大气。这并不好办。因此，最好一开始就杜绝二氧化碳的产生，方法是改变混凝土的另一个成分也就是骨料的接合方式。有意思的是，这或许是微生物可以大显身手的领域。

有一个方案不仅从效用上来说绿色环保，它本身就是绿色的。它利用了一种富含叶绿素的名叫蓝藻细菌的生物体，能进行光合作用。这让位于科罗拉多州的公司普罗米修斯材料（Prometheus Materials）研发出了一种生产水泥的方法，其中所用的能源不是来自热，而是光——光很容易通过电力获得，而电力又由可再生能源提供。而且，光合作用本身会减少而不是增加大气中的二氧化碳，这一点或许更为重要。

| 自种混凝土

普罗米修斯在装满水的“生物反应器”中培养这种细菌，反应器周围装有发光二极管，让这些细菌进行光合作用。水中含有细菌所需的无机营养物，并且不断向其中灌注气泡以提供二氧化碳。水中还含有溶解的钙离子——这是因为最终目的要促使这些细菌利用所提供的原料生成粒径为几微米的碳酸钙晶体。这一过程称为生物矿化。

如果不加干预，生物反应器中的细菌数量每四到六小时就会翻一番。但实际操作时，大量细菌会被定期转移到其他容器中。在那里，它们被不断注入一种可以加快生物矿化的独门刺激剂，然后静置一小时左右，让它们完成矿化。把由此产生的富含晶体的粘稠物和骨料混合在一起，就得到了“生物混凝土”。

事实上生物混凝土的种类有很多，这取决于它所用的骨料。目前，普罗米修斯打算把这种粘稠材料与沙子、以及一种名叫水凝胶的物质混合在一起。水凝胶的质地就像儿童派对上的果冻甜点，但它是工业材料，作用是让沙粒更好地粘结在一起。

为了减小混合料中颗粒之间的空隙，从而让生成的材料更牢固，普罗米修斯首先将混合料倒入模具中形成焦渣砌块，然后用机器对它进行约10秒钟的挤压，“拼命地振捣它”，普罗米修斯的老板洛伦·伯内特（Loren Burnett）说。如此生产的砌块大约八天即可硬化，而传统方法生产的砌块需要28天。

普罗米修斯表示，这样制造混凝土所排放的二氧化碳是传统方法的十分之一。伯内特希望这能让自己的公司收取“绿色溢价”——因为这种新型砌块不会比传统的焦渣砌块便宜。不过，他不会指望靠建筑行业的善举来实现这一目标。包括加州、俄勒冈和华盛顿州在内的许多司法管辖区都在推出支持“低碳”混凝土的法规。

要实现盈利需要收取多少溢价还不清楚，不过一旦普罗米修斯将生产从实验室转移到附近的试产工厂，应该就清楚了——该公司预计将在明年年初完成这一转移。即便如此，它还是希望最终能将成本降低到可与传统水泥生产商的价格竞争的水平。

目前尚不清楚这种新材料的透水性如何。但它确实很坚固。最新几批的混凝土能够承受每平方厘米380公斤的压力——优于一些传统混凝土。焦渣砌块和用来降低交通噪音的隔音砖（有看法认为水凝胶的降噪效果比传统混凝土更好，于是就有了这样的应用）都将于明年年初上市销售。而桥梁

预制节段上市需要的时间要稍长一点，因为对它的认证更严格。

普罗米修斯表示自己的新工厂每月将能生产近21,000块焦渣砌块。但由于长途运输重型产品的费用昂贵，该公司也在研究一种把细菌和晶体都风干的方法。伯内特表示，这种方法是希望生产一种“只需加水”的生物混凝土拌合物，它比传统的混凝土拌合物更轻，因此运费更便宜。

| 绿色增长

另一家位于北卡罗来纳州三角研究园（Research Triangle Park）的生物水泥公司Biomason也采用了类似的方法，只不过它培养的巴氏芽孢杆菌不能进行光合作用，因此除了要提供无机营养物，还必须提供糖、氨基酸等有机营养物。该公司的老板金杰·克里格·多西尔（Ginger Krieg Dosier）表示，这样得到的生物水泥在接合细颗粒物方面比传统水泥更好。如此一来，Biomason就可以使用尾矿砂之类的东西来替代一部分混凝土中的沙子。Biomason的首批产品是Biolith牌墙砖和地砖。

生物水泥的应用范畴也超出了传统建筑业。例如，美国国防部对此就很感兴趣，它希望能在偏远地区修建工程而不必大费周章地运送水泥等材料。如果拟运输路线上的地理条件还很恶劣的话，这种应用的价值就会倍增。事实上，正是美国国防部促成了普罗米修斯的创建——2017年，国防部向科罗拉多大学的科研团队拨款180万美元，这个团队后来创立了普罗米修斯。

国防部还以国防高级研究计划局（DARPA）和空军研究实验室（Air Force Research Laboratory）的名义与Biomason合作研发生物水泥喷剂，可以把沙地或疏松的土壤变成跑道。迈克尔·多西尔（Michael Dosier）是Biomason的首席技术专家（也是公司老板的丈夫），他说这种喷剂不到72小时即可完成固化。

甚至还有一些更出人意料用途也在酝酿中。今年8月，美国国防部副部长凯瑟琳·希克斯（Kathleen Hicks）在科罗拉多州柯林斯堡（Fort Collins）举行的DARPA Forward科技会议上发表演讲，勾勒了一个名副其

实的超凡脱俗的目标：能够在月球或火星的表土上喷洒一种含有细菌的液体，以“种出一个降落场”。

在现实中，生物水泥已被用来加固疏松的地面，这不仅仅是为了建造跑道。新加坡南洋理工大学（NTU）的研究人员正在研制一种生物水泥，打算用它来减缓海岸侵蚀。

为此，南洋理工大学的土木与环境工程系正在研制各种配方，将海水、氯化钙、尿素和大豆中的一种酶混合在一起。在研制出的一些批次中，氯化钙和尿素已经分别成功地被工业废料电石渣和人类尿液所取代。

南洋理工大学的生物水泥是一种与自身用途相契合的水状液体，而且一旦被加入混凝土中，就基本是无色的。这意味着“把溶液倒在海滩上就行了”，系主任楚剑表示。新加坡国家公园局（National Parks Board）正在两个被海浪侵蚀的海滩上测试这种水泥——一个位于新加坡南海岸边缘，另一个在一群离岸小岛上。

| 填补裂缝

荷兰的Basilisk公司生产了另一种用于建筑业的奇妙细菌混合物。2017年，该公司推出了一款可以修复混凝土裂缝的产品。

Basilisk自愈原剂（Basilisk Healing Agent）由微小颗粒组成，其中有属于动性球菌属、芽孢杆菌属和芽孢八叠球菌属的一些细菌的干孢子，还有包括聚乳酸在内的营养物。建筑工人在把水、骨料与传统水泥混合时，会将这种颗粒加入水泥中。未固化的水泥碱性高，可以阻止水分激活孢子。不过碱性会随着混凝土的固化而下降。这意味着如果出现裂缝，水进入裂缝，这些颗粒中蓄势待发的孢子就会立即行动起来，生成碳酸钙。这可以填满一毫米宽的裂缝，将有潜在危险的裂缝消灭在萌芽状态。

这不仅降低了维护成本，也意味着这种混凝土中需要用到的钢筋更少，因为传统混凝土会不可避免地开裂，而在计算所要使用的“螺纹钢”数量时要考虑开裂时所需的额外强度。因此，一立方米普通混凝土需要100至120公斤钢筋，每公斤成本约为一美元。Basilisk的老板巴特·范德沃德（Bart

van der Woerd) 表示, 加入五公斤Basilisk的颗粒可以使某些项目所需的钢筋数量减半, 而且只需要花费37欧元 (37美元)。

这不仅省了钱, 还减少了二氧化碳的排放——因为从铁矿石中炼钢又是一个不只因为需要生成能源、还因为化学反应而排放二氧化碳的过程。(铁矿石是氧化铁, 其中的氧与焦炭中的碳发生反应被分离出去后, 就留下了金属铁。) 所以减少用钢就是减少二氧化碳排放。这么看来, 善意铺就的路并不一定通往地狱, 有时也幸运地通往天堂。■



Welcome to the vertiport

A new type of air terminal opens for flying taxis

Urban air-travel takes a step closer

AS THE MORNING mist slowly clears over Pontoise-Cormeilles, a regional airport 40km north-west of central Paris, it is time to check in at the vertiport. This is the name the aviation industry has adopted to describe a new type of air terminal. Vertiports will be used by eVTOLs, or flying taxis as they are sometimes called. As the name indicates, these aircraft take off and land vertically, like helicopters. But instead of being powered by jet turbines they rely on sets of electrically driven rotors, much like hovering drones.

Pontoise-Cormeilles' vertiport, which opened on November 10th, so far serves only as a prototype—for, being the first of its kind in Europe, it has no matching facility to act as a destination. But Groupe ADP, which manages Paris's airports, including Pontoise-Cormeilles, hopes that will soon change. The Paris Olympics open in July 2024. By then the firm plans for at least two routes to be operating in the region, with a total of ten air taxis, each flying two or three trips an hour. These would link the Olympic Village with conventional airports and also with the Paris heliport at Issy-les-Moulineaux, on the southern side of the city near an emergency medical centre.

| *Quick exit*

The terminal building itself is compact—about as big as a medium-sized apartment. The idea is that, having bought a ticket using a mobile-phone app, a passenger can check in rapidly and paperlessly. A facial-recognition scan confirms identity and a floor sensor measures weight. This lets the craft, sitting on a pad just outside, calculate its load so that it knows how

much power will be needed for the journey, and thus when its batteries will require topping up. There should be barely enough time to grab a cup of coffee before the less-than-20-minute hop downtown, avoiding the snarling rush-hour traffic below.

If a passenger spends more than ten or 15 minutes in the terminal then something has gone wrong, says Duncan Walker, boss of Skyports, the British firm that built the facility. The eVTOL flying around outside it is made by Volocopter, a German company. Skyports has opened a similar vertiport in Marina, California, which is being used by Joby Aviation, an American outfit that is also developing a flying taxi, and is planning others in places that include London and Singapore.

In a dense urban environment, a vertiport needs to take up as little space as possible, which is why people will not be encouraged to linger. And there is another difference from either a conventional airport or a heliport: silence. As the eVTOL flies overhead it is strikingly quieter than a helicopter that landed near the main airport building a little earlier. “That’s your licence to operate in city centres,” says Mr Walker. Not only are flying taxis less noisy than helicopters, but if recharged from a renewable source of electricity they are greener and, being mechanically simpler, a lot cheaper to run.

Operating costs should fall even further, for eVTOLs are readily adaptable to autonomous flight. That frees up the pilot’s seat for an extra passenger. At first, however, regulators are expected to grant airworthiness certificates only to flying taxis with pilots on board. This will allow experience to be gained and the reliability of the craft to be tested before they are permitted to do without the pilot.

To get airborne quickly, most putative operators are therefore starting with piloted versions of their offerings. Volocopter appears to be in the lead. Its craft, VoloCity, has room for just a single passenger. Hot on its heels are

Joby, which is flight-testing a five-seater, and AutoFlight, a company based in Shanghai, which is flying a four-seater. Airbus, Europe's biggest aircraft-maker, is also developing a four-seat flying taxi that will, initially, be piloted.

Two exceptions to the general rule are Boeing, America's biggest aircraft-maker, which has teamed up with Wisk Aero, a Californian firm, to produce a four-seater, and a two-seater being tested by Ehang, another Chinese firm. Both of these projects aim for autonomy from the beginning.

Getting an airworthiness certificate is, however, only part of the process needed to begin commercial services. An airline-style operator's licence is also needed. The idea is that the first vertiports will help with this by demonstrating that flights are reliable, safe and can be integrated into existing air-traffic-control systems.

| *Prêt à transporter*

In theory, eVTOLs should show a good level of safety, for they have high levels of what engineers call redundancy—that is, duplication of critical systems. This comes about principally from their multiple rotors, which allow a craft to continue flying if one or more of its motors fails. A rotor failure in a helicopter means the pilot has to make an emergency landing by gliding to the ground using a technique called autorotation. If one of the 18 rotors on a VoloCity failed it would, by contrast, hardly be noticed, says Paul Stone, Volocopter's test pilot.

Mr Stone, who has flown more than 200 types of aircraft, including vertical-take-off jets, also observes that the computerised flight controls on a VoloCity make it “much simpler to fly, and therefore easier to learn”. At first, the pilots will be people with backgrounds flying either fixed-wing aircraft or helicopters, who will be trained to handle eVTOLs, too. Eventually, though, he expects a separate eVTOL licence will be created,

letting people learn to fly them from scratch. And even when autonomy arrives, piloting jobs will still be available. The plan is that qualified individuals sitting in control centres on the ground will monitor several flights each, as already happens with military drones, and will thus be available to take manual command in an emergency.

As technologies improve, eVTOLs' capabilities will grow. Much of that progress will come from developments in battery technology for electric cars, says Dirk Hoke, who recently took over as Volocopter's chief executive, having previously run Airbus's defence and space division. A bigger, faster version of VoloCity, using a new type of battery, is already on the way, he adds. But he would not go into details. By the end of the decade, though, it is not only Paris's notorious traffic that could be bypassed from above with the convenience of using a ride-hailing app, but the jammed roads of several other cities, too. ■



欢迎光临vertiport

一种供“飞的”停泊的新型候机楼

市内航空离现实更近了一步【新知】

随着晨雾慢慢散去，在巴黎市中心西北向40公里处的蓬图瓦兹-科尔梅耶（Pontoise-Cormeilles）支线机场，vertiport（“垂直起降机场”）开始办理登机了。Vertiport是航空业对一种新型候机楼的叫法，它主要供eVTOL（“电动垂直起降飞行器”，有时也叫做飞行出租车）使用。顾名思义，这些飞行器像直升机那样垂直升降。但它们不是由喷气涡轮提供动力，而是依靠多组电动旋翼，很像能悬停的无人机。

蓬图瓦兹-科尔梅耶的vertiport于11月10日启用，迄今为止还只是个样板项目——作为欧洲首个此类项目，它还没有全面运营所需的配套设施。但管理着包括蓬图瓦兹-科尔梅耶机场在内的多个巴黎机场的ADP集团（Groupe ADP）希望这很快就会改变。巴黎奥运会将于2024年7月开幕。届时，该公司计划在当地运营至少两条航线，共十辆飞行出租车，每辆每小时飞两三趟。它们将连接奥运村和常规机场，以及位于巴黎南部的伊西莱穆利诺（Issy-les-Moulineaux）一个紧急医疗中心附近的直升机场。

| 快速离港

这座候机楼本身很袖珍——和一套中型公寓差不多大。其设计思路是通过手机应用买好机票的乘客可以快速、无纸化办理值机。通过面部扫描确认身份，用地面传感器测量体重。停靠在外头一块停机坪上的飞行器就可以计算负载，了解本次航程需要多少电力，确定何时需要给电池充电。起飞前的候机时间应该只够买杯咖啡，不到20分钟便可直达市中心，完全避开高峰时段拥堵混乱的地面交通。

建造这座候机楼的英国公司Skyports的老板邓肯·沃克（Duncan Walker）说，如果乘客在候机楼停留的时间超过10或15分钟，那肯定是哪里出问题了。在它外头来回飞的eVTOL则由德国公司Volocopter制造。Skyports已经在加州的马里那（Marina）开设了一个类似的vertiport，供

同样开发飞行出租车的美国公司Joby Aviation使用，同时也在规划伦敦和新加坡等地的项目。

在人口密集的城市环境中，vertiport需要尽可能减少占地面积，因此并不鼓励人们在那里逗留。与传统机场或直升机场相比，vertiport还有一个不同之处：安静。当eVTOL飞过头顶时，它比一架刚刚降落在主候机楼附近的直升机要安静太多了。“这就是能够在市中心运营的通行证。”沃克表示。飞行出租车不仅比直升机噪音小，如果用可再生能源充电的话也更环保，而且它的机械结构更简单，运营成本也低得多。

eVTOL可以方便地改造为无人驾驶飞行器，运营成本还会进一步下降。这样就能腾出飞行员的座位，多搭载一名乘客。不过，一开始监管部门估计只会向配备飞行员的飞行出租车颁发适航证。这样可以不断积累经验，检验飞行器的可靠性，直到获准取消飞行员。

因此，为了快速启动业务，大多数潜在运营商都从有人驾驶的模式入手。Volocopter似乎跑在最前头。它的飞行器VoloCity只能容纳一名乘客。紧随其后的是Joby和总部位于上海的峰飞航空科技，它们分别正在试飞五座和四座的飞行器。欧洲最大的飞机制造商空客也在开发一款四座的，最初也会有飞行员驾驶。

有两家公司没有走寻常路。美国最大的飞机制造商波音正与加州的Wisk Aero公司合作生产一款四座飞行器，另一家中国公司亿航正在测试一款双座飞行器。这两个项目从一开始就以无人驾驶为目标。

然而，获得适航证只是开始商业运营的步骤之一，还需要获得类似航空公司的运营牌照。业界的想法是，第一批vertiport应该会有助于证明这类飞行安全可靠，并且可被纳入现有的空中交通管制系统，这将有助于申请牌照。

| 打个“飞的”

理论上，eVTOL应该有很好的安全性，因为用工程师的话来说，它们具备很高的冗余度，即关键系统有多套备份。这主要缘于它有多组旋翼，即使

其中一个或多个马达失效，仍然可以让飞行器继续飞行。直升机一旦发生旋翼故障，飞行员就必须采用一种名为“自旋”的技术，依靠滑翔紧急降落。相比之下，VoloCity的试飞员保罗·斯通（Paul Stone）说，如果VoloCity的18个旋翼中有一个失灵，你甚至都注意不到。

斯通驾驶过200多种飞机，包括垂直起降的喷气飞机，他还表示，计算机化的飞行控制让VoloCity“驾驶起来简单得多，因而也更容易学”。起初，飞行员将由拥有固定翼飞机或直升机飞行经验的人来担任，他们还要接受eVTOL的飞行训练。不过，他预计最终将另外设立单独的eVTOL执照，让零基础的人也可以学习驾驶这种飞行器。而且即使实现了无人驾驶飞行，飞行员仍有用武之地。现在的计划是在地面控制中心里安排经过考核的人员，他们将每人监控几架飞行器的航程——就像目前对军用无人机采用的做法。发生紧急情况时他们可以手动接管。

随着技术的进步，eVTOL的能力还将不断增强。曾主管空客的防务与航天部门、最近接任Volocopter首席执行官的德克·霍克（Dirk Hoke）说，进步将主要来自电动汽车电池技术的发展。他补充说，一款使用新型电池的更大、更快的VoloCity快要问世了。但他不愿透露更多细节。不过，在本个十年结束前，人们应该能很便捷地使用“打飞的”应用升空，不仅能避开巴黎那出了名混乱的地面交通，还有好几个其他城市的拥挤道路。■



Vault face

Why central banks are stockpiling gold

The metal offers a hedge against inflation—and a way to circumvent sanctions

IN 1968 THE London Bullion Market closed for two weeks. The world's largest precious-metal market had run out of gold, drained by a five-month run on America's stash by European central banks. The crisis marked the beginning of the end for the Bretton Woods standard that had kept the dollar pegged to gold, and currencies elsewhere to the dollar, since 1944.

Now central banks are furiously buying gold again (see chart). In the third quarter alone 400 tonnes moved into their reserves. That has pushed the total from January to September to 670 tonnes, a pace unseen since the Bullion Market debacle. In May Turkey snapped up almost 20 tonnes in one go. India and Qatar are also ravenous. The metal now makes up two-thirds of Uzbekistan's reserves, months after it planned to reduce gold to under half. Kazakhstan is also doubling down.

In part this is because gold, snubbed in good times because it generates no yield, recovers its shine in times of volatility and high inflation. In the long run, it is seen as a store of value and, not tied to any individual economy, seems immune to local political and financial turmoil. Central bankers may also think they are getting a bargain. Even though it has resisted better than most, the price of the metal has dropped 3% this year. Gold bugs expect a rebound.

Like in the past, however, buying gold bars is also a way to ditch some dollars. Except this time it is not Europe but emerging markets who grumble about the greenback. They need dollars to pay for imports and external debts. But their reserves are mostly made of treasuries, not actual banknotes. And as the Federal Reserve has raised interest rates, buoying

yields, the value of government paper has dropped. Lesser central banks have taken this as a cue to swap them for precious metal rather than bet on the Fed taming inflation.

Shadier motives are also at play. Gold provides a way to circumvent Western sanctions on Russia, much of whose reserves have been frozen since March and whose banks have mostly been disconnected from the dollar-based international-payments system. Almost no central banks keep roubles as foreign-currency reserves. For those countries that traditionally do a fair bit of business with the Kremlin—from Turkey to Turkmenistan—gold offers an alternative, if clunky, means of exchange. This motley group of emerging markets have been among the biggest buyers of gold this time around.

This is not something the West can do much about. Russian gold is banned on the London market, but no one can get at its gold reserves, which are mostly sourced from its own mines. And Russia's central bank no longer reports how much gold it holds, making swaps impossible to track. Moving the physical metal is a logistical headache, but it keeps transactions under the West's digital radar, which is useful for those playing both sides—like Qatar or Turkey. The World Gold Council, a trade body, says unknown buyers account for a big chunk of this year's bonanza.

One consolation for the dollar is that no other currency is gaining ground. The portion of foreign reserves held in yuan globally has stalled this year. The euro, yen and pound are treading water too. Central banks may have gold fever but there is no regime change on the horizon. ■



金库大挪移

各国央行为何囤积黄金

黄金提供了一种对冲通胀的手段——和一种规避制裁的方法

伦敦黄金市场在1968年曾休市两周。当时这个全球最大的贵金属市场的黄金储备消耗殆尽，原因是欧洲各国央行对美国黄金储备持续五个月的挤兑。这场危机标志着布雷顿森林体系开始走向终结。自1944年以来，布雷顿森林体系一直将美元与黄金挂钩，而其他国家的货币与美元挂钩。

现在各国央行又开始疯狂购买黄金（见图表）。仅第三季度就有400吨黄金被收入各家央行的储备。这将今年1月至9月的购买总量推高至670吨，是自伦敦黄金市场崩盘以来从未有过的速度。5月，土耳其一口气抢购了近20吨黄金。印度和卡塔尔也如饥似渴。乌兹别克斯坦原本计划将黄金在储备中的比例减少到一半以下，但几个月后的现在，黄金已占到该国储备的三分之二。哈萨克斯坦也在加码购买黄金。

之所以出现这种情况，部分原因是黄金这种在经济景气时期因无法产生收益而受冷落的资产在市场波动和高通胀时期会耀眼起来。从长远来看，它被视为一种价值储存手段，与任何单个经济体无关，似乎不受本地政治和金融动荡的影响。此外央行行长们可能觉得现在买黄金很划算。尽管它已经比大多数其他资产都抗跌，但今年以来价格下跌了3%。黄金投资者预计金价会反弹。

不过，就像过去一样，购买金条也是抛售美元的一种方式。只不过这次抱怨美元的不是欧洲，而是新兴市场。它们需要美元来支付进口和外债。但它们的外汇储备大多是美国国债，不是真正的美元。随着美联储加息，债券收益率受提振，美国国债的价值已经下降。较小经济体的央行视之为一个信号，认为该把美元换成贵金属，而不是押注美联储能抑制通胀。

更不上台面的动机也在起作用。黄金提供了一种规避西方对俄罗斯的制裁的方法。自今年3月以来，俄罗斯的大部分外汇储备已被冻结，该国的银

行大多已被踢出以美元为基础的国际支付系统。几乎没有哪家央行将卢布作为外汇储备。对于从土耳其到土库曼斯坦等传统上与俄罗斯有不少生意往来的国家来说，黄金虽然很笨重，但毕竟提供了另一种交换手段。这些形形色色的新兴市场是这一次黄金热潮的最大买家。

对此，西方国家能做的很有限。俄罗斯的黄金被禁止进入伦敦市场，但没人能对它的黄金储备下手，它们大多出自俄罗斯自己的矿山。此外，俄罗斯央行不再公布其黄金持有量，因此无法追踪掉期交易。运送实物黄金在物流上让人头疼，但能在西方的数字雷达下继续交易，对那些耍两面派的国家有用处，比如卡塔尔或土耳其。行业组织世界黄金协会（World Gold Council）表示，匿名买家占了今年囤金潮的很大一部分。

能让美元感到安慰的是，还没有其他货币在扩大阵地。今年人民币在全球外汇储备中所占的比例停滞不前。欧元、日元和英镑也原地踏步。各国央行或许掀起了淘金热，但短期内美元的统治地位不受影响。■



Trainer trouble

The sportswear giants are running into hurdles

Misbehaving rappers are not the only problem

FOLLOWING A SERIES of anti-Semitic outbursts in October, Kanye West, a rapper and fashion entrepreneur (who insists on being called Ye), bragged that Adidas would never get rid of him. Within days, the German sportswear giant proved him wrong, ending a lucrative seven-year relationship. Mr West's line of Yeezy sneakers added €1.5bn (\$1.5bn) to Adidas's revenues in 2021, or 12% of its entire shoe business. After the announcement, the company's share price fell to lows unseen since 2016. On November 9th Adidas cut its profit forecast for the fourth time this year. The previous day it had named a new chief executive, Bjorn Gulden, to clean up the mess.

Mr Gulden, who had helped turn round Adidas's German arch-rival, Puma, will have to deal with more than just misbehaving pop stars. Much like the rest of the global sportswear industry, which earns revenues of \$300bn a year, Adidas is battling post-pandemic supply-chain glitches, inflation-fuelled cost increases and an economic slowdown in its biggest markets. Even the football World Cup, which kicks off on November 20th in Qatar, is unlikely to offer the usual sales boost, as many shoppers pinch pennies.

Sportswear firms' most immediate problem concerns their inventories. As quarantined consumers snapped up hoodies and tracksuit bottoms, the companies ramped up production of athleisure wear. In June last year Nike, the industry's American heavyweight, confidently forecast annual revenue growth of 10% or so until 2025 and sales that year of \$50bn. Instead, the firm is slashing prices to dump unsold stock. It now expects revenues to grow by 5% or so a year.

A longer-term problem is managing the move away from sports and towards fashion. Besides making the companies vulnerable to the whims of mercurial pop stars, this has exposed them to competition at both the fashionable end of the market, where luxury labels are peddling trainers, and at the sporting end, where rookie firms offer innovative products that appeal to buyers' evolving sensibilities about both athletic performance and matters like the environment. On Running, a Swiss brand in which Roger Federer, a tennis legend, owns a stake, makes its footwear from beans and has launched a subscription service to replace and recycle well-worn kicks. In March Lululemon Athletica, an athleisure label, launched its first footwear collection. HOKA claims to have reinvented the running shoe with its signature chunky cushioning.

Still, the contest in the fashion market looks like more of a struggle for companies that made their names on the field rather than on the catwalk, notes John Kernan of Cowen, an investment bank. Some are already returning to their sporting roots. Puma's success under Mr Gulden, a former professional footballer in his native Norway, has a lot to do with focusing on kit for underserved sports, such as cricket and motor racing. Adidas will be hoping for similarly fancy footwork. ■



运动鞋之困

运动服饰巨头的障碍跑

问题不只是行为不当的说唱歌手

在10月份爆出一连串反犹言论后，说唱歌手兼时尚公司老板坎耶·维斯特（Kanye West，他坚持管自己叫Ye）还夸口说，阿迪达斯永远不会甩了他。然而没过几天，这家德国运动服饰巨头就证明他想错了，解除了和他已经延续七年的利润丰厚的合作关系。韦斯特设计的椰子（Yeezy）系列运动鞋在2021年为阿迪达斯带来了15亿欧元的收入，占其整个鞋类业务的12%。消息公布后，阿迪达斯股价跌至2016年以来的最低点。11月9日，阿迪达斯今年第四次下调了利润预期。就在前一天，它任命了新的CEO比约恩·古尔登（Bjorn Gulden）来收拾这个烂摊子。

古尔登曾帮助阿迪达斯的德国劲敌彪马扭转颓势，这一次他要处理的还不仅仅是行为失当的流行歌星。与全球运动服饰行业（该行业年收入3000亿美元）中的其他企业一样，阿迪达斯也在应对诸多问题，比如疫情后供应链不畅、通胀引发成本上涨，以及它最大的几个市场经济放缓等。即便是11月20日在卡塔尔开幕的世界杯足球赛也不太可能像以往一样提振销售，因为眼下许多消费者都在捂紧钱包过日子。

运动服饰公司的当务之急是清库存。由于封控期间消费者抢购连帽衫和运动裤，这些公司加大了运动休闲装的生产。去年6月，该行业的美国巨头耐克信心满满地预测，收入每年都会增长10%左右，一直持续到2025年，届时销售额将达到500亿美元。但事与愿违，耐克现在正在清仓大甩卖。现在它预计收入年增速在5%左右。

一个更长远的问题是如何从运动向时尚偏转。这样的转型除了让这些公司容易受到反复无常的流行歌星一时任性的影响，还让它们同时面对这个市场两个方向的竞争：时尚端——奢侈品牌也在售卖运动鞋；运动端——新锐公司推出创新产品以迎合买家日益在意运动性能和环保等问题的趋势。网球传奇人物罗杰·费德勒持股的瑞士品牌On昂跑（On Running）用豆

类制作鞋子，并推出了更换和回收旧鞋的订阅服务。今年3月，运动休闲品牌露露乐蒙（Lululemon Athletica）首次推出鞋类产品。HOKA号称用自己标志性的厚实缓冲材料彻底改进了跑鞋。

尽管如此，时尚市场上的竞争似乎让那些成名于运动场而非T台的公司感到吃力，投资银行Cowen的约翰·柯南（John Kernan）指出。一些公司正在回归自己运动品牌的根基。古尔登曾在自己的母国挪威当过职业足球运动员，他执掌下的彪马之所以取得成功，和专注于为板球和赛车等市场远未饱和的运动项目提供服饰装备有很大的关系。阿迪达斯也会希望自己能走出类似的漂亮步法。 ■



Buttonwood

How crypto goes to zero

The implosion of FTX has raised questions about the tech's future

IF EVERYONE STOPPED using it. That, in five words, is how crypto would go to zero. Still, the journey is more interesting than the destination. The death of FTX, an exchange declared bankrupt on November 11th after a spectacular blow-up, will encourage some people to turn their attention elsewhere. What would have to happen for everyone to give up?

An answer requires a sense of how the industry works. At crypto's base are blockchains, like Bitcoin and Ethereum, which record transactions verified by computers, a process incentivised by the issuance of new tokens. The Ethereum blockchain validates lines of code, which has made it possible for people to issue their own tokens or build applications. These include stablecoins, which are pegged to real-world currencies, and tokens like Uniswap, which manage decentralised-finance (DeFi) protocols. Major chains and a handful of Ethereum-based tokens, like stablecoins, account for about 90% of cryptocurrency value. Big businesses have been built on top of this world, including exchanges, investment funds and lending platforms.

To take out crypto entirely would require killing the underlying blockchain layers. They could either give way first, kicking the stool out from underneath everything else. Or the industry could unravel from the top down, layer by layer like a knitted scarf.

Knocking the stool out is extraordinarily hard, and the current high value of bitcoin and ether makes it even harder. To attack a blockchain and shut it down requires gaining 51% control of the computational power or value of tokens staked to verify transactions. The more valuable the tokens, the

more energy it takes to attack a proof-of-work chain, like Bitcoin, and the more money to attack a proof-of-stake chain, like Ethereum. The security of these chains—as measured by the amount someone would have to spend to attack them—is now in the region of \$10bn to \$15bn. It would require either a government or an extraordinarily rich individual to mount such an attack. And even if Elon Musk was so inclined, he seems a little busy at present.

Unravelling is therefore the more conceivable path. The events of this year have revealed just how prone to this sort of thing crypto is. The implosion that seems to have set the chaos in motion was that of Terra-Luna, a decentralised stablecoin system, worth around \$40bn at its peak. It collapsed in May, wiping \$200bn off the market capitalisation of crypto. That led a few weeks later to the demise of several lending platforms and a hedge fund, events which wiped another \$200bn off the market cap. The margin calls these platforms faced appear to have imperilled Alameda, the trading firm owned by Sam Bankman-Fried, and prompted the decision to use FTX customer funds to plug the gap. When FTX failed, it wiped another \$200bn off crypto's market cap. Now other exchanges and lending platforms look to be in trouble.

Beady-eyed readers will note that most of this stuff, apart from Terra-Luna, is in the “on top of” category and not actually on-chain tech. DeFi exchanges and lending protocols have continued to whirr even as the enterprises more akin to normal businesses have imploded one by one. But the collapse of these enterprises could imperil the underlying tech by taking out chunks of its value, making the chains more exposed to would-be attackers and pushing miners or stakers to switch off their machines. The value of on-chain activity and tokens is self-reinforcing. The more people that use DeFi, the more valuable Ethereum becomes. The higher the price of ether, the higher the hurdle to attack the blockchain and the more confidence people will have that blockchains will endure. This also works

in reverse. The more people shy away from crypto out of fear, the less secure it becomes.

The total market cap of cryptocurrencies is currently \$820bn. That is 70% below the peak a year ago, but still high compared with most of crypto's history. It is higher than at the start of last year, for instance, and any point before then, including the peak of the bull market in 2017. Many more layers—such as a major stablecoin, big businesses or perhaps other on-chain protocols—would have to unravel to take crypto's value back to the levels at which it traded just three or four years ago. Crypto's reputation has been undermined before. It has collapsed in value repeatedly throughout its lifetime. Although fewer people will use crypto as a result of the FTX collapse, it is very hard to imagine the number will be small enough to take its value to zero. ■



梧桐

加密货币如何归零

FTX暴雷让币圈前景成疑

谁都不用了——如果加密货币一朝归零，这五个字便是原因。但是，过程比结果更有趣。在惊天爆雷之后，加密货币交易所FTX于11月11日宣布破产，它的垮台将促使一部分人将注意力转向别处。但在什么情况下才会让所有人都放弃加密货币呢？

要回答这个问题，首先要对这个行业的运作方式有所了解。加密货币的底层基础是区块链，例如比特币和以太坊，这些区块链记录了经过计算机验证的交易，这个验证过程以发行新代币作为激励手段。以太坊区块链验证的是一行行代码，这使得人们可以发行自己的代币或构建应用。其中就有与真实世界货币挂钩的稳定币，以及管理DeFi（去中心化金融）协议的Uniswap等代币。大型区块链和少数基于以太坊的代币（如稳定币）约占加密货币价值的90%。在这个世界的基础上已经形成了各种大型业务，包括交易所、投资基金和借贷平台。

要完全消灭加密货币，将需要摧毁基础的区块链层。它们可以率先崩塌，等同于把支撑在所有其他东西下方的凳子踢掉。或者整个行业也可以自上而下地瓦解，就好像把针织围巾一层层拆散。

把这张凳子踢翻绝非易事，而现在比特币和以太币的高市值更让这难上加难。要攻击和关停区块链，需要控制验证交易所需的算力或者代币质押价值的51%。代币价值越高，攻击比特币等工作量证明（proof-of-work）链所需的电力就越多，攻击以太坊等权益证明（proof-of-stake）链所需的资金也越多。按照攻击所需花费的资金来衡量，这些区块链的安全性目前在100亿至150亿美元之间。只有一国政府或者某位巨富才能发动这样的攻击。即使马斯克有这种想法，他现在似乎也抽不出身。

因此，拆毛线似乎是更行得通的途径。今年发生的诸多事件显示了加密货

币多么容易出现这类问题。引发连串危机的似乎是Terra-Luna的爆雷，这个去中心化的稳定币系统在巅峰时期市值达到约400亿美元。它在今年5月轰然崩塌，令加密货币市值瞬间蒸发2000亿美元。几周后多个借贷平台和一家对冲基金相继倒闭，加密货币市值又抹去2000亿美元。这些平台所面对的追缴保证金要求似乎也危及了山姆·班克曼-弗里德（Sam Bankman-Fried）旗下的交易公司阿拉米达（Alameda），促成了动用FTX客户的资金来填补缺口的决定。FTX倒台之后，加密货币的市值又损失了2000亿。现在，其他交易所和借贷平台似乎也有麻烦。

眼尖的读者会注意到，除了Terra-Luna外，出问题的大部分都属于上层结构，而非真正的链上技术。在更像普通公司的企业一个个倒闭之时，DeFi交易所和借贷协议仍在继续运转。但是这些企业爆雷也可能会动摇技术根基，因为区块链的市值遭到大幅削弱后，会更容易受到潜在攻击，并促使矿工或质押者关停机器。链上活动和代币价值是一种自我强化的循环。使用DeFi的人越多，以太坊就越有价值。以太币的价格越高，攻击这一区块链的障碍就越高，人们就越相信区块链能够经受住考验。反之亦然。人们越是因为恐惧而回避加密货币，它就越不安全。

目前，加密货币的总市值为8200亿美元，与一年前的峰值相比下挫了70%，但与加密货币历史上的大部分时间相比仍然处于高位。例如，当前市值仍高于去年年初的水平，也高于此前的任何时刻，包括2017年牛市的峰值。要让加密货币的价值回归到三四年前的水平，还需要更多层面上的瓦解，例如某个主要的稳定币、大企业，或者其他链上协议。加密货币过去曾有过名声扫地。在其整个历史中价值也曾几经暴跌。尽管FTX崩塌后使用加密货币的人会减少，但很难想象这个数字会小到足以让加密货币价值归零。■



Bartleby

How to do lay-offs right

That means thinking primarily about the people who are left behind

IT'S NOT just Twitter. The pink slips are piling up at some of the biggest names in tech. Mark Zuckerberg, the founder of Meta, is eliminating more than 11,000 roles, around 13% of the social-media company's workforce. On November 22nd HP announced up to 6,000 job losses, which would be around 10% of the IT firm's staff. Amazon's boss, Andy Jassy, has warned of more cuts next year, on top of those already unveiled in the retailer's devices and books businesses. Stripe revealed that 14% of the staff at the digital-payments firm were being let go. Snap and Shopify announced their own rounds of lay-offs earlier in the summer.

Jobs are disappearing in other industries, too. Investment banks have started paring staff in anticipation of a slowdown in dealmaking. Property firms are laying people off as housing markets cool. Beyond Meat, which makes plant-based products, cut almost 20% of its workforce in October.

The people who suffer most from lay-offs are those who lose their jobs. But the colleagues who are left behind also endure lasting consequences; and for managers, this group is the one that determines success. Some suffer a form of survivors' guilt, asking themselves why they kept their jobs and colleagues did not. (Only at Twitter do the people leaving feel guilty about those who are left behind.) Others must grapple with the practicalities of replacing departed workers and with the stress of heightened job insecurity: if the axe has fallen once, it may do so again.

The results can be depressed morale, lower productivity and unexpected costs. Research conducted in 2008 by two academics at the University of Wisconsin-Madison found that, for an average company, downsizing the

workforce by 1% was associated with a 31% increase in voluntary turnover rates. That means more disruption as well as additional money spent on filling open positions.

To keep survivors motivated, managers need to get three things right. The first imperative is to appear fair. This is a capacious concept. Fairness involves treating departing colleagues well: one particular wrinkle with the current tech lay-offs is that they affect lots of immigrant workers, whose eligibility to remain in America is now in doubt. It means showing sensitivity about executive compensation: saying that downsizing is the hardest thing you've ever done is less credible when profit-related bonuses end up paying for another weekend house.

Fairness also means sharing the rationale for why individual people have gone, whether because they sat in sputtering businesses or because their own performance was questionable. "Stacked-ranking" systems, in which employees are forced into a ranking of highest to lowest performers, are increasingly out of favour. But in theory at least, they do provide a merit-based measure for decisions on where to make cuts. According to The Information, a news site, Google is going to increase the proportion of employees it identifies as low performers.

If decision-making about who gets the chop appears capricious, then managers will also fail to achieve their second goal: to assure survivors that they don't need to start looking for a new role, too. It matters that lay-offs do not become regular events. Research conducted at a large manufacturer in 2003 found that workers who had been exposed to repeated rounds of cuts felt less secure in their jobs and had greater intention to quit. In his memo in August, Evan Spiegel, Snap's boss, made a point of saying that a 20% reduction in the social-media firm's workforce should substantially reduce the risk of more axings.

The third area of focus is workload. Cutting headcount and asking the survivors to do more might seem like a marvellous idea in head office. Some bosses say so outright: Elon Musk, chopper-in-chief at Twitter, is open about his belief in long hours by small teams. But it is a risky approach, as likely to reduce job satisfaction as yield leaps in productivity. Downsizing has a greater chance of succeeding if the burden on remaining employees does not spike.

None of this is easy territory. Lay-offs are bound to leave scars. But managing the fallout is simpler if the employees who are left behind still trust their bosses to get the big things right. Many of the memos being fired off by tech leaders contain apologetic admissions that they expanded their workforces too fast as a result of the pandemic. The honesty is necessary but it can plant another doubt in survivors' minds: if they can foul up once, why not again? ■



巴托比

如何做好裁员

主要是要替留下来的人着想

不仅是推特。其他一些科技巨头也是解雇信满天飞。社交媒体公司Meta的创始人扎克伯格正着手裁撤超过11,000个职位，约占员工总数的13%。11月22日，IT公司惠普宣布将裁员多达6000人，约占员工总数的10%。零售巨头亚马逊的老板安迪·贾西（Andy Jassy）警告称，除旗下设备和图书业务已公布的裁员决定之外，明年还将进一步裁员。数字支付公司Stripe透露正在裁减14%的员工。Snap和Shopify在夏季已各自宣布了一轮裁员。

其他行业的岗位也在消失。投行预见到未来交易将减少，也开始纷纷裁员。随着楼市冷却，房地产公司裁员不断。生产植物基人造肉的Beyond Meat在10月裁员了近20%。

在裁员潮中日子最难过的莫过于丢掉工作的人。但是留下的同事也要忍受持久的影响，而对管理者来说这群人正是决定成败的关键。其中有人心生“幸存者愧疚”，看着同事走人，会质疑自己何德何能可以保住工作。（唯独在推特，是离开的人对留下来的感到愧疚）。还有些人必须要实际接手被裁同事的工作，心下担心着饭碗不保的可能性又加大了：斧头砍下过一次，就可能有下一次。

结果可能是士气低落、工作效率降低和产生意想不到的成本。威斯康星大学麦迪逊分校的两位学者在2008年的研究发现，对于普通公司来说，裁员1%与自愿离职率上升31%相关联。这意味着不仅要额外花钱填补职位空缺，还引发了更多混乱。

想让留下来的员工保持干劲，管理者要做对三件事。首要任务是摆出公平的姿态。这是个宽泛的概念。公平包括善待被裁的同事，在目前这一轮科技业裁员中，一个特别的后遗症是受影响的很多是移民员工，他们能否继续留在美国现在已经成问题。那么，在高管的薪酬安排上就要更多地体察

其他人的观感：如果你先说裁员是自己做过的最艰难的决定，转头又拿着与利润挂钩的奖金再买一栋周末度假屋，那这所谓的艰难决定就不太能让人信服了。

公平还意味着要公开辞退每个员工的依据，不管是所在的部门业绩不佳，还是个人工作表现有问题。将员工按绩效生硬划为三六九等的“末位淘汰”制度日益不流行了。但至少在理论上，它们确实为裁员从何处下手提供了一个基于业绩的度量方法。据科技新闻网站The Information报道，谷歌将把更大比例的员工划入低绩效范围。

如果有关裁员对象的决策给人随心所欲之感，那么管理者也将无法实现第二个目标：让留下来的人相信他们不需要开始寻找新工作。重要的是，不能让裁员成为惯常操作。2003年在一家大型制造企业内开展的研究发现，在目击多轮裁员后，员工的工作安全感下降，离职意愿上升。社交媒体公司Snap的老板埃文·斯皮格尔（Evan Spiegel）在8月给员工的备忘录中特意指出，公司一次性裁员20%应该能大大减低未来发生更多轮裁员的风险。

第三个重点是工作量。或许在公司高层看来，裁减人手并要求留下来的人做更多是个绝妙的点子。一些老板对此不加掩饰。推特的“首席裁员官”马斯克明言，小团队、长工时才是出路。但这是条冒险的道路，它可能带来生产率的飞跃，却同时令工作满足感骤降。让留下来的员工不致负担激增，缩编才更有可能取得成功。

这三件事都非易事。裁员必然造成创伤。但如果留下来的员工仍相信自家老板能把持好大方向，管理后遗症就会更简单一些。许多科技公司老板仓促发出的备忘录都语带歉意地承认，由于新冠疫情，他们让员工队伍扩张过快了。这种坦诚是必要的，但也可能在幸存者的心中埋下另一个疑问：他们既然能搞砸一次，为何不会有第二次？ ■



Changing the wheels

The race to reinvent the car industry

Can carmakers catch up with Tesla and pull off the shift to software?

AFTER A DAY'S work, you are not quite ready to go home. Perhaps you fancy catching a film. You could head to the cinema. Instead, you retreat into your car. A few taps on the touchscreen dashboard and the vehicle turns into a multimedia cocoon. Light trickles down the interior surfaces like a waterfall. Speakers ooze surround-sound. Augmented-reality glasses make a screen appear in front of your eyes.

This immersive experience is at the core of what Nio, a Chinese electric-vehicle (EV) company, laid out as the future of the car at a launch party in October in Berlin. The firm wants its high-end EVs to be a “second living room”. Forget horsepower, acceleration and design—Nio emphasises the two dozen high-resolution cameras and transistors (of which there are 68bn, about four times as many as in the latest iPhone) in their vehicles. “We have a supercomputer in our cars,” boasts Nio's boss, William Li.

Nio is at the forefront of a revolution in the car industry: the archetypal hardware business is becoming ever more about software. Immutable objects that do not change after they leave the factory are turning into dynamic platforms for applications and features which can be updated “over the air”. Rather than deteriorate with age, such “software-defined vehicles” can improve over the years. Brands will become defined less by handling or mechanical excellence, and more by the services they offer, from safety features and infotainment to artificially intelligent driving aids. Nio's cars come equipped with an AI assistant called Nomi, whose circular interface sits on top of the dashboard and smiles when you ask it questions.

Like all revolutions, this one promises to usher in a new world. It will certainly benefit motorists and digitally native carmakers such as Nio or Tesla, America's EV champion. It will also claim victims, mostly among incumbent carmakers steeped in the culture of mechanical engineering. The boss of Volkswagen, Herbert Diess, recently lost his job after botching the German giant's software plans. For many of VW's rivals, too, the shift is proving thornier than managing the other big transition, from the internal-combustion engine to electric power. It may also prove more consequential. Luca de Meo, boss of Renault, a French carmaker, likens the situation to the upheaval wrought on telecommunications by the smartphone. The shift will define the fate of a global industry with revenues of nearly \$3trn.

Cars have been accumulating software for decades. For the most part, however, code was deeply embedded in a car's parts, powering the "electronic control units" of such things as the ignition, brakes and steering. Most of these programs were developed by the carmakers' suppliers and came in completed units that were then assembled into a vehicle. Car firms "were mostly integrators", explains Klaus Schmitz of Arthur D. Little, a consultancy.

In recent years this setup has started to collapse under its own complexity. As more software was added, it became harder to make all the pieces work together, explains Andreas Boes of ISF Munich, a think-tank. In June 2020 VW postponed for months the launch of the ID.3, a new EV, because of software troubles. Software engineers like to untangle such messes by creating a "platform"—to equip cars with a central computer powered by an operating system (OS) that comes with standardised digital plugs for additional components (application programming interfaces, or APIs, in the jargon) and a connection to the computing clouds.

This technical transformation, in turn, has triggered a knotty cultural one.

In the old hardware world, car companies were hierarchical, process-oriented organisations often run by big egos. Launching a new model took around four years and the focus fell on meeting the deadline for the all-important start of production. A new model was much the same as the old one, with precious little innovation, says Henrik Fisker, who once designed Aston Martin and BMW sports cars and now runs an EV startup bearing his name. In the new software world, by contrast, decentralised teams of developers focus more on problem-solving than on execution. Cars are updated in rhythms counted not in years but in days and sometimes hours. Products are never really finished.

This is second nature to newcomers such as Tesla—which was conceived as a software company that happened to make cars and is now the world’s most valuable carmaker—as well as Nio and others, whose valuations belie their current limited output (see chart). For the incumbents, it requires radical reinvention. Established carmakers are furiously recruiting chief software officers (CSOs), developing their own OSs and holding “software days” to present digital strategy to investors. But most have yet to create an organisation capable of straddling hardware and software; to decide which pieces of software to keep firmly under their control and develop in-house and which to outsource; and to come up with a profitable business model for services made possible by all the code.

Take the organisational challenge first. The trick is to strike a balance between keeping development of software and hardware for different parts of a car in separate vertical groups and getting a “horizontal” software unit to write the programs, says Ondrej Burkacky of McKinsey, another consultancy. Cling too closely to the vertical approach and your software “will look like your org-chart”, he says—something plainly displayed on many incumbents’ car dashboards. Turn too horizontal and your software unit will get overwhelmed. That is what happened at VW, critics say, which installed its Cariad division in Ingolstadt, a six-hour drive from the group’s

headquarters in Wolfsburg.

| *Gear shift*

Other carmakers are learning from VW's mistakes and adopting more mixed models. BMW and Stellantis (whose biggest shareholder, Exor, also part-owns The Economist's parent company) will spread their software teams around the world, closer to where the related hardware is made. Stellantis recently launched a "Data and Software Academy" intended to retrain more than 1,000 of the firm's existing employees per year, as well as hiring talent worldwide, with the aim of having 4,500 engineers by 2024. Mercedes-Benz has just invested €200m (\$206m) in an ultramodern "Electric Software Hub", which will one day house 1,000 programmers in the middle of its research-and-development campus in Sindelfingen, close to its headquarters in Stuttgart. "Here they can easily work with any department," explains Magnus Östberg, the firm's CSO.

Although most carmakers now say they employ several thousand coders, this can be misleading. Many of the programmers are still steeped in the old world of embedded software, not the new one of platforms and cloud computing. And quality is more important than quantity, says Doug Field, who used to work at Apple and Tesla and now oversees software at Ford. The best programmers are not just 20% better than the average, they are ten times better, he points out. Makers of luxury cars, such as Mercedes-Benz and BMW, will always be attractive employers for such brainboxes. For lowlier brands, it can be a struggle to afford the high salaries and cushy work environments. "You have to accept if they want to come to work at 10am wearing bunny slippers," says Mr Field.

Moreover, making the mechanical engineers who still dominate the industry work with software engineers, who will increasingly take a lead, will not be easy. One side is trained to achieve the perfect Spaltmaß, a German word for the gap between a car's body panels. The other has no

problem putting out half-baked “beta” products and collecting feedback from users. Making these cultures dovetail takes time, says Anja Hendel of Diconium, a firm that helps manufacturers build software divisions. One of the purposes of initiatives like Stellantis’s academy and Mercedes-Benz’s hub is to speed up the process.

Even with thousands of top-notch programmers, the car firms will not be developing all their software by themselves. Even doing just 60% in-house, VW’s goal with Cariad, looks ambitious. Other carmakers are aiming at closer to 20-30%. That in turn means getting outside help.

VW tacitly acknowledged as much on October 13th, when it announced that Cariad would invest €2.4bn in a joint venture with Horizon Robotics, a Chinese firm, in part to develop software for the Chinese market. Stellantis has teamed up with Amazon to build a “SmartCockpit” which it can then customise for its brands. BMW is working with Qualcomm, a chip firm, to co-develop parts of a car OS—which Qualcomm will then offer to other carmakers. Mercedes-Benz will reportedly fork out over 40% of the revenues from software and updates to Nvidia in exchange for access to the chipmaker’s processors and programs.

Mass-market firms may opt for Android Automotive, a software package developed by Google. Indeed on November 8th Renault announced a deepening of its relationship with the tech firm to speed its digital transformation by developing a centralised platform. Big technology firms “give us the initial speed”, says Yves Bonnefont, Stellantis’s CSO.

Collaboration presents a dilemma, however: whether to develop a differentiated product over which the car firms have control, or whether to “forgo control and adopt a platform that consumers appear to readily accept”, as Bernstein, a broker, notes. They want to avoid the fate of PC-makers, which the tech giants turned into profitless commoditised

businesses by inserting themselves between their products and customers. Most want to keep things such as the “user interface” (what used to be called the dashboard) and safety systems in-house. These are increasingly considered the soul of a brand—as is the overall architecture of a car’s software and the data it generates.

“Any co-operation has to be structured in such a way that we keep control of all the car’s data,” insists Frank Weber, who heads development at BMW. To temper the power of big tech, Mr Weber has long been calling for German carmakers to share costs by jointly developing software that does not differentiate them. So far the industry’s competitive instincts have prevailed. But an open-source project for software-defined vehicles within the Eclipse Foundation, an umbrella organisation for carmakers as well as tech firms for such initiatives, has recently gained momentum.

Launched by ETAS, the software arm of Bosch, a supplier of car parts, and Microsoft, a software giant, the project makes a stab at becoming to the automotive industry what Android is to smartphones: a platform shared by many manufacturers. It could help create a European “car OS”, which might be able to compete better in a world where you can expect a couple of American OSs, maybe one from Japan, and another from China. Old brands and new (Gucci-mobile anyone?) could then be built on one of these digital platforms.

Even if the carmakers succeed in creating their software-defined vehicles, they must also work out how to make money from them. Many eye a pot of gold at the end of the digital transition, in the form of margin-boosting revenues from services. These range from streaming entertainment and self-driving add-ons to tailored insurance policies and even temporary hardware features. BMW recently announced a subscription service for heated seats, at a cost of \$18 a month. Last year VW said it believed industry revenues from software could hit €1.2trn in 2030, around a quarter of the

total market for moving people and things on wheels (or “mobility”, as the industry insists on calling it). Stellantis expects its software and service revenues to reach €4bn a year by 2026 and €20bn by 2030—with tech-like net margins of 20% to boot, twice what even a premium carmaker ekes out at the best of times.

Many analysts are sceptical; they reckon that many of these services will eventually be included free as competitors try to win customers. “There is always that one firm that does it without charging for it,” says Patrick Hummel of UBS, an investment bank. And though features such as “full self-driving”, which Tesla offers for \$15,000, may be tempting, it is far from certain that car-owners will part with money for things that once came at no cost, such as keeping their bums warm.

Each of these changes—to digital technology, organisation and business models—is a big shock on its own. Together they amount to a handbrake turn for an industry characterised by inertia. Many established firms still do not seem to accept the scale of the challenge. Digitisation has yet to creep into boardrooms: more than a third of board members at the four big German carmakers are mechanical engineers, and none comes from the tech industry.

For now, though, the digital race is still to be won. Even as the car industry struggles with software, the upstarts have much to learn about getting Spaltmaß right at scale, maintaining complex supply chains and building trust in their brands. “Incumbents are not doomed like Nokia,” says Christoph Bornschein of TLGG, another consultancy, referring to a once-dominant firm caught out by the smartphone revolution. “But they have only a narrow window of opportunity to get their act together.” ■



更换车轮

一场重塑汽车行业的竞赛

老牌车厂能赶上特斯拉并成功向软件转型吗？【深度】

结束了一天的工作，你还不太想回家。或许你想看场电影。你可以去电影院。你没有去，而是钻进了自己的车里。轻点几下触控仪表盘，你的车变成了一个多媒体“包厢”。光线像瀑布一样洒落在车内。扬声器里流淌出环绕立体声。戴上增强现实眼镜，电影银幕出现在你眼前。

这种沉浸式体验是蔚来在10月柏林的发布会上展示的汽车未来的核心。这家中国电动汽车公司希望把自己的高端电动车打造成“第二客厅”。忘掉马力、加速能力和设计吧——蔚来强调的是车上24个高分辨率摄像头和680亿个晶体管（大约是最新款iPhone的四倍）。“我们的车里装了一台超级计算机。”老板李斌自豪地说。

蔚来走在汽车产业的一场革命的前沿：这个传统上典型的硬件业务正变得日益关乎软件。原本在出厂后便固定不变的不可变对象正在变成动态平台，其中的应用程序和功能可以远程无线升级。这种“软件定义的汽车”不但不会年久老化，还会不断改良。定义品牌的主要因素将不再是操控或机械性能，而是它们提供的服务，包括安全性能、车载信息娱乐，以及人工智能辅助驾驶等。蔚来的汽车配备一个叫作Nomi的人工智能助手，它圆形的界面位于仪表盘的上方，听到提问时会呈现微笑的表情。

和所有革命一样，这场革命有望开创一个新世界。这无疑会让驾驶者以及像蔚来和美国电动车业老大特斯拉这样的数字原生车厂受益。但同时也会产生一批受害者，主要是拘泥于机械工程文化的传统车厂。德国汽车巨头大众的老板赫伯特·迪斯（Herbert Diess）不久前就因为搞砸了公司的软件计划而丢了工作。对于大众的许多竞争对手来说也是一样：这种转变比另一个从内燃机到电动机的大转变更加棘手。其影响也可能更重大。法国汽车制造商雷诺的老板卢卡·德·梅奥（Luca de Meo）将这种局面比作智能手机给电信业带来的巨变。这一转变将决定一个全球收入近三万亿美

元的行业的命运。

几十年来，汽车中的软件越来越多。但大部分情况下，代码都深嵌在汽车的部件中，用来驱动点火装置、刹车系统和转向装置等“电子控制单元”。这些程序大多由车厂的供应商开发，以完整单元的形式提供，然后被组装进整车。汽车厂商“基本上是集成商”，理特咨询公司（Arthur D. Little）的克劳斯·施密茨（Klaus Schmitz）解释说。

近年来，由于其中的复杂性，这种做法开始土崩瓦解。随着添加的软件越来越多，让所有部件协同工作也变得越来越困难，智库ISF Munich的安德里亚斯·伯斯（Andreas Boes）解释说。2020年6月，由于软件故障，大众将新款电动汽车ID.3的发布推迟了好几个月。为了理清这团乱麻，软件工程师们想要创建一个“平台”——为汽车配备一个由操作系统（OS）驱动的中央计算机，它带有可连接附加组件的标准化数字插头（业内称为应用程序接口，也就是API），并可连接到计算云。

这种技术转变继而引发了一种复杂的企业文化转变。在传统的硬件主导的世界里，车厂是分等级、重流程的组织，管理者通常都很自负。推出新车型要花四年左右的时间，其中的重点就是赶上至关重要的最后投产期限。新旧车型大同小异，创新少之又少，亨里克·菲斯克（Henrik Fisker）表示。他曾经为阿斯顿·马丁和宝马设计跑车，现在创办了一家以自己名字命名的电动汽车创业公司。相比之下，在软件主导的新世界里，权力被下放到各个开发团队，它们更关注解决问题而不是执行任务。汽车更新周期不是按年来计算，而是按天甚至是小时计。产品永远没有大功告成的时候。

这样的文化对特斯拉、蔚来等造车新势力来说是自然而然的。特斯拉最初就被构想为一家软件公司，只是碰巧生产汽车，它现在是全球市值最高车厂；蔚来等公司的市值和它们目前还很有限的产量不匹配（见图表）。对老牌车厂来说，这需要彻底的改造。它们正大举招聘首席软件官

（CSO），开发自己的操作系统，通过举办“软件日”向投资者展示数字化战略。但它们大多数还没有建立起一个能够软硬件通吃的组织结构；没有

决定哪些软件应该牢牢掌控在自己手里、自主研发，而哪些应该外包出去；也没有为用代码实现各类服务提出一个可盈利的商业模式。

首先来看组织架构方面的挑战。另一家咨询公司麦肯锡的奥德雷伊·布尔卡奇（Ondrej Burkacky）表示，诀窍是要在以下两者间达成平衡：保持在独立、垂直的部门里为汽车的各个部分研发软硬件；同时让一个“横向的”软件部门来编写程序。他表示，如果过于偏向垂直模式，你的软件“看起来就会像你公司的组织结构图”一样——许多传统车厂的汽车仪表盘都清楚展现了这一点。过于偏向横向模式，你的软件部门又会不堪重负。批评人士说，大众就是在这方面没做好。它将旗下的软件公司卡里亚德（Cariad）设在了距沃尔夫斯堡（Wolfsburg）的集团总部六小时车程的因戈尔施塔特（Ingolstadt）。

| 换挡

其他车厂正从大众的错误中吸取教训，采用更偏混合的模式。宝马和Stellantis（其最大股东Exor也拥有本刊母公司的部分股权）将把自己的软件团队分散到世界各地，以靠近相关硬件的生产地。Stellantis不久前成立了一个“数据和软件学院”（Data and Software Academy），每年对1000多名现有员工进行再培训，并在全球范围内招聘人才，争取到2024年拥有4500名工程师。梅赛德斯-奔驰不久前刚投资两亿欧元（2.06亿美元）建造了一个超现代化的“电动软件中心”（Electric Software Hub）。这个中心未来会有1000名程序员，安排在辛德芬根（Sindelfingen）的研发园区里，离斯图加特的梅赛德斯-奔驰总部不远。“在这里，他们可以轻松地与任何部门协作。”公司的CSO马格努斯·奥斯博格（Magnus Östberg）解释说。

尽管如今大多数车厂都说自己雇用了几千名程序员，但这种说法可能有误导性。其中许多程序员仍然深陷在嵌入式软件的旧世界里，而不是平台和云计算的新世界中。而且质量比数量更重要，曾经任职于苹果和特斯拉、如今在福特主管软件部门的道格·菲尔德（Doug Field）表示。最优秀的程序员可不是比一般程序员好出20%，而是一个顶十个，他指出。在这些天才眼里，梅赛德斯-奔驰和宝马等豪华汽车制造商永远都是有吸引力的

雇主。而对于较低端的品牌来说，提供高薪和舒适的工作环境可能会很困难。“如果他们想在上午10点穿着兔子拖鞋来上班，你就得接受。”菲尔德表示。

此外，让仍是行业主导者的机械工程师与日益成为领头人的软件工程师合作也不容易。前者接受训练来打造完美的Spaltmaß（德语，指车身面板之间的缝隙）。而后者完全可以推出不成熟的“测试版”产品并收集用户反馈。让两种文化对接起来需要时间，帮助制造商建立软件部门的公司Diconium的安雅·亨德尔（Anja Hendel）表示。Stellantis的数据和软件学院以及梅赛德斯-奔驰的电动软件中心等举措的目的之一就是加快这种对接。

即使有成千上万的顶级程序员，汽车制造商也不会自主开发所有软件。即便像大众为卡里亚德设定的目标那样只是自主研发60%的软件，看上去也还是很艰巨。其他车厂的目标是接近20%至30%。这就意味着要得到外部帮助。

大众对这一点也心知肚明：10月13日，它宣布卡里亚德将投资24亿欧元与中国机器人公司地平线成立合资公司，目标之一是为中国市场开发软件。Stellantis已与亚马逊合作打造一款“智能驾驶舱”，可以为它自己的品牌提供定制。宝马正与芯片公司高通合作，共同开发一部分汽车操作系统，之后高通可以把这部分系统提供给其他车厂。据报道，梅赛德斯-奔驰将拿出其软件及升级收入的超过40%给英伟达，以换取使用这家芯片制造商的处理器和程序。

面向大众化市场的车厂可能会选择使用谷歌开发的Android Automotive软件包。事实上，雷诺在11月8日宣布将深化与谷歌的合作，通过开发一个中心化平台来加速自己的数字化转型。科技大公司“给我们提供了初始速度”，Stellantis的CSO伊夫·博纳丰（Yves Bonnefont）表示。

然而，这种合作带来了一个两难困境：正如经纪公司盛博所指出的，是开发由各车厂自己控制的差异化产品，还是“放弃控制权，采用一个消费者

似乎乐于接受的平台”。它们希望避免重蹈个人电脑制造商的覆辙——科技巨头通过把自己横插在电脑产品和客户之间，将厂商变成了无利可图的日用品企业。大多数车厂希望把“用户界面”（过去叫作仪表盘）和安全系统等东西控制在自己手里。这些东西越来越被认为是一个品牌的灵魂，就像汽车软件的整体架构及其生成的数据一样。

“任何合作都必须按这种方式构建，让我们能够控制所有的汽车数据。”宝马的研发主管弗兰克·韦伯（Frank Weber）坚称。为了削弱科技巨头的影响力，韦伯长期以来一直呼吁德国的汽车制造商共同开发无差别软件来分担成本。不过迄今为止，该行业的竞争本能还是占了上风。但Eclipse基金会（Eclipse Foundation）的一个软件定义汽车的开源项目最近势头良好。这个伞状组织协调车厂和科技公司的这类举措。

该项目由汽车零部件供应商博世（Bosch）的软件部门易特驰（ETAS）和软件巨头微软发起，试图成为汽车行业的安卓：一个由许多制造商共享的平台。它可能有助于构建一个欧洲版的“汽车操作系统”，这样或许能更好地参与未来的竞争，那时预计会有两三个美国的操作系统，可能还有一个日本的和一个中国的。老字号和新品牌（古驰牌汽车有人感兴趣吗？）那时都可以建立在其中一个数字平台上。

即使汽车制造商成功造出了自己的软件定义汽车，它们也必须想出从中赚钱的办法。许多车厂都在盯着数字转型完成时的那一桶金——服务收入提振利润。这些服务包括流媒体娱乐、自动驾驶附加软件、量身定制的保险等，甚至还包括一些短期的硬件功能。宝马前不久就宣布了一项座椅加热的付费解锁服务，每月订费18美元。大众去年表示，相信到2030年汽车行业的软件相关收入将达到1.2万亿欧元，约占整个人员和物品运输（业界坚持称之为“移动出行”）市场价值的四分之一。Stellantis预计自己每年的软件和服务收入到2026年将达到40亿欧元，到2030年将达到200亿欧元，而且能像科技企业那样实现20%的净利润——即使是高端汽车制造商在最好的时候，净利润也只能勉强达到10%。

许多分析人士对此表示怀疑；他们认为，随着竞争对手争相吸引客户，其

中许多服务最后都会免费附送。“总会有那么一家不收费的公司。”投资银行瑞银集团（UBS）的帕特里克·哈梅尔（Patrick Hummel）表示。尽管有些功能或许很吸引人，比如特斯拉售价1.5万美元的“全自动驾驶”系统，但车主们是否舍得为那些曾经免费的东西（比如座椅加热）花钱，还远不能确定。

数字技术、组织架构和商业模式——每一项变革都会带来巨大的冲击。三者叠加在一起，对一个怠惰成性的行业来说，无异于是让它来个手刹过弯。许多老牌车厂似乎仍然不愿承认这一挑战的严峻性。数字化尚未渗透进它们的董事会会议室：德国四大车厂的董事会成员中超过三分之一是机械工程师，没有一人来自科技行业。

不过，就目前来看，这场数字化赛车仍然输赢未定。就在汽车行业艰难转向软件的同时，那些新势力也有很多需要学习的地方，包括如何批量打造完美Spaltmaß、维护复杂的供应链，以及树立品牌信誉。“传统车厂不是像诺基亚那样败局已定。”咨询公司TLGG的克里斯托夫·博恩沙因（Christoph Bornschein）表示，他举出的这家公司曾经雄霸一方，却因智能手机革命而陷入困顿。“但留给它们整顿队伍来完成高难度转弯的时机不多了。”■



The Economist Film

Blackholes: why they matter? Trailer

Unlocking their secrets could be the key to understanding the very fabric of our universe.



经济学人视频

预告：了解黑洞为何重要？

解密黑洞可能是了解宇宙构造的关键。



Fleshing out the invisible hand

“For Profit” offers thrilling tales of commercial endeavour

Corporations often start out with the public good in mind. It doesn't last

For Profit. By William Magnuson. Basic Books; 368 pages; \$32 and £25

THERE IS NO mention of Elon Musk in William Magnuson's magnificent history of corporations, which stretches from the *societas publicanorum* of ancient Rome, through Renaissance Florence, the Age of Discovery and the might of American industrial capitalism to Silicon Valley. Yet reading it makes clear why the pioneer of electric cars, private rockets—and now, via Twitter, controller of part of the public sphere—commands attention. For more than 2,000 years, corporations such as his have produced some of humankind's greatest achievements. But usually the most dazzling overstep the mark, leaving a trail of debris and distrust behind them.

The contention of the book is that private enterprises often have public interest in mind. They are, as Mr Magnuson sees it, orchestrators of the invisible hand of Adam Smith's “The Wealth of Nations”. Selfish individuals, looking out solely for themselves, co-operate with each other to the benefit of society as a whole.

For much of corporate history, serving society was part of their charter. Rome's *publicani*, or publicans, were government contractors who built the republic's roads, temples, aqueducts and the like, provided the empire's supply chains—and milked its subjects for taxes. One chapter illustrates the almost insurmountable task facing the Union Pacific Railroad Company, under charter from Congress to bind America together after the civil war. It barely knew how to make railways, let alone pay for them. The terrain was unforgiving. The masterminds were at each other's throats. When the Union Pacific, heading west, and the Central Pacific, heading east, met in

Utah in 1869, setting off a frenzy of urbanisation and transcontinental commerce, poets including Walt Whitman were caught up in the national mood of celebration.

Over time, charters have gone, but corporations still bear the public good in mind—in some cases at least as much as profit. Henry Ford wanted to create low-priced cars made by highly paid workers. The Ford Motor Company was organised “to do as much good as we can, everywhere, for everybody concerned”, he once said, rather than to make ever more money. When Mark Zuckerberg launched Facebook, profit was low among his priorities, the book states. To start off with, he was far more focused on growth, in order to create network effects that made the site more enjoyable as more people used it.

Yet inevitably the public spirit degenerates into excessive greed, egomania or the abuse of power—with dangerous political consequences. The Roman *societas* ended up repressing foreign peoples and fostering military conflict. The East India Company, from 1600 to 1874, became too big to fail. Monopolists used Union Pacific to strangle commerce. Ford’s cult of efficiency morphed into creepy control over his workers—parodied in Aldous Huxley’s “Brave New World”, in which dates are measured from the “Year of Our Ford”. At Facebook engagement has come at the cost of privacy. Sometimes rogues have used the social-media platform to meddle with elections and disrupt democracy.

Mr Magnuson can stretch the point about business altruism too far. In a chapter on private equity, it is hard to believe that KKR, a buy-out pioneer, is as much, as he likes to put it, Flash Gordon (“noble, self-sacrificing”) as Gordon Gekko (“greed is good”). But within eight well-researched corporate dramas, he provides useful business lessons, too. As a law professor, he eloquently explains how issues such as principal-agent problems, competition law and environmental and labour rights have cropped up

throughout history.

He draws sensible conclusions from this. Corporations cannot hope to put public interest above all else for long; what the public wants is far too complicated for them to fathom. When businesses wade into politics, they play an outsize role in shaping it. Yet the belief that the pursuit of profit will always benefit society as a whole is also sadly erroneous, the author says. ■



让“看不见的手”现形

《逐利》讲述了扣人心弦的企业奋斗史

企业一开始往往会心系公众利益，但不会长久如此【《逐利》书评】

《逐利》，威廉·马格努森著。Basic Books出版社，368页；32美元/25英镑。

威廉·马格努森（William Magnuson）写下了宏伟的企业发展史，从古罗马叫作“公共索西艾塔斯”（societas publicanorum）的公共社团说起，串连起文艺复兴时期的佛罗伦萨、大航海时代，再到强大的美国工业资本主义，一直说到硅谷。其中并没有提及马斯克。然而，读了这本书，我们就能明白为什么这位电动汽车和私人火箭的先驱——如今又通过收购推特掌控了部分公共领域——值得关注。两千多年来，像他的公司那样的企业创造了一些人类最伟大的成就。但最耀眼的公司往往会越界，在身后留下一地鸡毛，不再受人信赖。

这本书的观点是，私营企业通常会心怀公共利益。在马格努森看来，它们是亚当·斯密在《国富论》中所说的“看不见的手”的编排者。只顾自己的自私自利的个体为了整个社会的利益而相互合作。

纵观企业发展史，服务社会在很多时候都是它们特许状的一部分。罗马的“包税人”（publicani）是政府的承包商，他们建造了罗马共和国的道路、庙宇、引水渠等等，负责罗马帝国的供应链，并向国民收取税金。书中一个章节阐述了当年摆在联合太平洋铁路公司（Union Pacific Railroad Company）面前的几乎无法完成的任务。在美国国会的特许下，它要把内战后的美国各地连接起来。这家公司几乎不知道怎么建铁路，更不用说筹措建造的资金了。地形条件非常恶劣。决策者们常常吵得不可开交。1869年，向西筑路的联合太平洋铁路公司和向东筑路的中央太平洋铁路公司（Central Pacific）在犹他州会合，从而掀起了城市化和横贯北美大陆的商贸狂潮，包括沃尔特·惠特曼（Walt Whitman）在内的很多诗人当时都沉浸在举国欢庆的气氛中。

世易时移，特许状不复存在，但企业仍然注重公共利益——在某些情况下至少把它看得和利润一样重。亨利·福特希望生产经济型汽车，同时自己的工人都是高薪一族。他曾说，福特汽车公司的组建是为了“尽我们所能，在所及之处，让所有相关人员受益”，而不是为了赚越来越多的钱。书中写道，马克·扎克伯格在创建Facebook时，盈利不是他优先考虑的事情。在一开始，他格外专注于扩张，就是为了创造网络效应——使用Facebook的人越多，它的使用体验就越好。

然而，公益精神不可避免地沦为过度贪婪、极端利己，或滥用权力——带来危险的政治后果。罗马的公共社团到头来开始镇压外来民族、煽动军事冲突。从1600年到1874年，东印度公司（East India Company）成了“大到不能倒”的巨头。垄断者利用联合太平洋铁路公司扼制商业。福特对效率的膜拜演变成了对员工可怕的控制——这在奥尔德斯·赫胥黎的《美丽新世界》中遭到戏谑式的嘲讽，这本书中的纪年是从“我们的福特元年”开始计算的。在Facebook上，用户参与度是以牺牲隐私为代价的。有时还会有不良之徒利用这一社交媒体平台干预选举、扰乱民主。

马格努森对于商业利他主义的阐述可能有些言过其实。在关于私募股权的一章中，人们很难相信收购先驱KKR集团就像他说的那样，既是电影《华尔街》中宣称“贪婪即为善”的戈登·盖柯（Gordon Gekko），也是《闪电侠戈登》中“高尚、自我牺牲”的闪电侠戈登。但在八个调查详实的企业故事中，作者也提供了一些有益的经验与教训。作为一名法学教授，他雄辩地解释了委托与代理问题、竞争法、环境权和劳工权利等议题是如何在公司发展的历程中意外出现的。

他从中得出了一些合理的结论。企业无法长久做到公共利益至上；公众的诉求太过复杂，不是企业能捉摸透的。当企业介入政治时，会对政治产生过分大的影响。但是，作者表示，相信追逐利润总能造福整个社会的观点也是大错特错的。■



Persistent prices

Even a global recession may not bring down inflation

The world economy is slowing dangerously

INVESTORS HAVE swooned at the good news. Since early October European shares have risen, with optimists declaring an end to the continent's energy crisis in sight. Chinese stocks have jumped at recent talk that Xi Jinping will abandon his "zero-covid" policy, and as regulators have loosened their curbs on the property sector. On November 10th, on the news that America's consumer-price inflation had come in slightly below economists' expectations, the tech-heavy NASDAQ index rose by 7%, one of the biggest ever daily moves, as investors priced in lower interest rates.

But take a step back, and the outlook has in fact darkened in recent weeks. The global economy is slowing, perhaps into a recession, as central banks ramp up interest rates to battle a once-in-a-generation surge in prices (see chart 1). Even with one month of better-than-expected data for America, there is scant evidence that inflation is anywhere near defeated (see chart 2). Indeed, in much of the world it is broadening out.

For most of this year people have worried about a downturn. In June Google searches for "recession" neared a record high. For a long time, however, the gloomy rhetoric ran ahead of reality. Output in the median rich country increased by about 1.3% from the end of 2021 to the third quarter of this year—not spectacular, but not bad. In the year to September the average unemployment rate in the OECD, a club of mostly rich countries that accounts for about 60% of global GDP, fell by close to one percentage point. Joblessness in the euro area hit an all-time low. Consumer spending was strong, with hotels, planes and restaurants packed the world over.

Now reality has caught up with the rhetoric. Higher borrowing costs are

starting to bite. In many countries, including Canada and New Zealand, house prices are falling as homebuyers face expensive mortgages. Housebuilders are cancelling projects, and homeowners are feeling less wealthy. Other companies are also reining in spending. In their latest monetary-policy report the Bank of England's researchers note that costlier finance is "weighing on investment intentions". The minutes of a recent Federal Reserve meeting observe that fixed investment by businesses has "already started to respond to the tightening of financial conditions".

Deteriorating economic conditions are beginning to show up in "real-time" data. Goldman Sachs, a bank, publishes a "current-activity indicator", a month-by-month measure of economic strength. In October, for the first time since the initial covid-19 lockdowns in 2020, rich-world economies appeared to shrink (see chart 3). Likewise, a global survey of purchasing managers indicates a contraction for the first time since June 2020. Since July a "nowcast" of global annualised GDP growth produced by JPMorgan Chase, another bank, has fallen by half.

Optimists point to strong labour markets. America's formidable jobs machine has slowed, but is still whirring, adding more than 250,000 positions in October. Elsewhere, though, signs of weakness are emerging. Claudia Sahm, an economist, has suggested that a recession is nigh when the average of the unemployment rate over the past three months rises by at least 0.5 percentage points relative to its low during the previous year. We find that eight out of 31 rich countries currently meet this criterion, including Denmark and the Netherlands. This is not a high proportion compared with, say, the beginning of the global financial crisis of 2007-09. But it does signal that a serious slowdown is now under way.

The "Sahm rule" reveals another important truth: that different countries are moving at very different speeds. Aside from America, a number of places, including Australia and Spain, are still growing at a decent rate. Yet

others are in trouble. Sweden, where high interest rates are hurting a particularly frothy housing market, is losing steam fast. Britain is now almost certainly in recession. In Germany sky-high energy prices are forcing industrial shutdowns. It may be faring the worst of all rich countries.

How severe will the downturn be? Households in rich countries are still sitting on trillions of dollars of “excess savings”, which they accumulated in 2020-21 from stimulus cheques and other fiscal support. This money will allow them to continue spending, even in the face of falling real incomes. New research by Goldman Sachs finds that large private-sector saving surpluses are associated with less severe recessions. And healthy savings pots mean economic pain is less likely to translate into financial distress. Mortgage-delinquency rates are actually declining in America, and are extremely low in New Zealand and Canada.

| *Marching orders*

Labour markets are weakening, but a rise in unemployment like that seen after the financial crisis is unlikely. This is because demand for labour has a long way to fall before it matches supply. Early this year the two were seriously out of whack, with the number of unfilled vacancies across the OECD peaking at 30m, according to our calculations. Now as demand falls, vacancies rather than jobs seem once again to be taking the strain. We estimate that the number of unfilled positions has fallen by a tenth since the high, but the number of filled posts is static.

Much depends on the path of inflation. Central banks are willing to induce a recession in order to lower it. Higher rates may bring “some softening of labour-market conditions”, as Jerome Powell, the chairman of the Fed, noted earlier last month. “We do think that [raising rates] is going to dampen demand, we’re not going to pretend this is pain-free,” warns Philip Lane, chief economist of the European Central Bank. Both economic theory

and data over the past seven decades suggest that falling GDP is associated with a large decline in the speed of price rises. But the lags between tighter monetary policy and lower inflation are not well understood. Central banks may have to cause more pain than they anticipate.

In some countries lower energy and food prices are helping to drag down the headline rate of inflation. America's recent figures for October were better than economists expected. In general, though, prices are not heading in the direction that central bankers would like. Inflation "surprises" across the rich world, when reported data come in higher than forecast, are still common (see chart 4). According to figures released on November 16th, inflation in Britain was 11.1% in October, well above economists' expectations. On the same day, Canadian data showed no sign of waning inflation. Almost everywhere "core" inflation, which reflects underlying price pressure better, is rising. In three dimensions—breadth, wages and expectations—rich-world inflation is getting more, not less, entrenched.

Begin with breadth. When the inflationary surge started last year, it was confined in most countries to a small number of goods and services. In America it was second-hand cars. In Japan it was food. In Europe it was energy. This provided false comfort to pundits, many of whom assumed that once the prices of these few components stopped rising, overall inflation would fizzle out.

In fact, the inflation virus has spread. We analysed the consumer baskets of 36 mostly rich countries. In June 60% of prices in the median basket were rising by more than 4% year on year. Now 67% are. Even in Japan, the land of low inflation, the prices of a third of the basket are rising by more than 4%. This broadening out is in part due to an exceptionally strong dollar, which raises inflation by making imports more expensive. But it is more to do with what is happening in domestic economies.

This is where the second dimension—wages—comes in. Pay is a guide to the future path of inflation: when companies' labour costs rise, they tend to pass them on to customers in the form of higher prices. Inflation optimists point to data from America, where there is some evidence of a pay slowdown, albeit from increases of 6% or more year on year. Growth in Britain also seems to have peaked at a high-but-no-longer-rising rate.

Elsewhere, though, there is not much evidence of restraint. New research from Pawel Adrjan of Indeed, a jobs website, and Reamonn Lydon of the Central Bank of Ireland suggests that nominal pay in euro-zone job postings is rising by more than 5% year on year, and is still accelerating. French wage inflation “has further to go”, reckons JPMorgan. In Germany IG Metall, a big union for metals and engineering workers, is seeking a pay rise of up to 8%. In New Zealand, Norway and Sweden pay growth is still rising. This is not what you would expect at a time when the economic outlook is dire.

The third dimension is expectations. Alternative Macro Signals, a consultancy, runs millions of news articles in several languages through a model to construct a “news inflation pressure index”. The index, which has proved to be a good predictor of official numbers, is still elevated. Similar evidence comes from Google-search data, which suggests that global interest in inflation has never been so high.

Survey-based measures of expectations similarly provide no evidence of weakening inflation. Figures put together by the Cleveland Fed, Morning Consult, a data company, and Raphael Schoenle of Brandeis University gauge the public's inflation expectations in various rich countries. According to the survey for October, in the median country the public reckons prices will rise by 5% over the next year, as it has in previous months (see chart 5). The inflation expectations of companies—the economic actors that actually set prices—are just as concerning. A survey

by the Cleveland Fed, based on research by Bernardo Candia, Olivier Coibion and Yuriy Gorodnichenko, three economists, finds that American firms currently expect inflation of 7% over the next year, the highest level since the survey began in 2018.

| *Painful ignorance*

Everyone can agree on one thing about the past year. It has demonstrated just how poorly economists understand inflation, including both what causes it and what causes it to persist. It is likely, therefore, that economists will also struggle to predict when inflation will cool. Optimists hope that prices will once again take people by surprise, with their rise slowing sooner than expected. But it seems more likely that inflation will prove stubborn even as the economy slows. That will leave policymakers with a grim choice: to squeeze the economy tighter and tighter, or to let prices spiral.

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顽固的价格

哪怕全球经济衰退也可能无法降低通胀

世界经济正在危险地放缓

好消息让投资者狂喜沉醉。自10月初以来，乐观主义者宣布欧洲大陆的能源危机即将结束，欧洲股市上涨。在中国，最近有传言称习近平将放弃其“清零”政策，并且监管机构放松了对房地产行业的限制，股市随之大涨。11月10日，在美国消费者价格通胀略低于经济学家预期的消息发布后，随着投资者把较低的利率计入股价，以科技股为主的纳斯达克指数上涨7%，这是有史以来最大的单日涨幅之一。

但退一步看，最近几周前景实际上是变得更暗淡了。随着各国央行提高利率以应对数十年未见的价格飙升，全球经济正在放缓，甚至可能陷入衰退（见图1）。即使美国数据有1个月好于预期，也几乎没有证据表明通胀已接近受控（见图2）。事实上，在世界大部分地区，通胀正在愈演愈烈。

在今年的大部分时间里，人们都在担心经济衰退。6月，“经济衰退”的谷歌搜索量接近历史新高。然而，很长一段时间里，悲观的言辞都跑在了现实的前面。从2021年底到今年第三季度，中等富裕国家的产出增长了约1.3%——算不上出彩，但也还不错。在截至9月的一年中，经合组织（一个主要由富裕国家组成的俱乐部，占全球GDP的60%左右）的平均失业率下降了近一个百分点。欧元区的失业率创历史新低。消费者支出强劲，世界各地的酒店、飞机和餐馆纷纷爆满。

眼下，现实追上了预言。更高的借贷成本开始产生影响。在包括加拿大和新西兰在内的许多国家，由于购房者面临昂贵的抵押贷款，房价正在下跌。房屋建筑商正在取消项目，房主感觉不那么富有了。其他公司也在控制开支。在最新的货币政策报告中，英格兰银行的研究人员指出，更高的融资成本正在“影响投资意向”。最近的美联储会议纪要指出，企业的固定资产投资“已经开始对金融环境的收紧作出反应”。

不断恶化的经济状况开始出现在“实时”数据中。高盛银行发布了一项“当前活动指标”，这是一种按月衡量经济实力的指标。自2020年初的新冠疫情封锁以来，富裕世界的经济体似乎在10月首次出现萎缩（见图3）。同样，全球采购经理人调查显示，自2020年6月以来首次出现收缩。自今年7月以来，另一家银行摩根大通发布的全球年化GDP增长“临近预报”已经下降了一半。

乐观主义者指出劳动力市场依然强劲。美国强大的就业机器已经放缓，但仍在运转，在10月份新增了超过25万个职位。不过，在其他地方，疲软迹象正在冒头。经济学家克劳迪娅·萨姆（Claudia Sahm）表示，当过去三个月的平均失业率相对于上一年的低点上升至少0.5个百分点时，经济衰退就临近了。我们发现，目前31个富裕国家中有8个符合这一标准，包括丹麦和荷兰。与2007至2009年全球金融危机之初时相比，这一比例并不高。但这确实表明经济正在严重放缓。

“萨姆规则”揭示了另一个重要的事实：不同国家的增长速度截然不同。除美国外，包括澳大利亚和西班牙在内的许多地方仍在以可观的速度增长。然而，其他国家却遇到了麻烦。瑞典的高利率正在冲击一个特别泡沫化的房地产市场，导致其迅速失速。英国现在几乎肯定处于衰退之中。在德国，高昂的能源价格迫使工业停工。它可能是所有富裕国家中最糟糕的。

经济衰退会有多严重？富裕国家的家庭仍然坐拥数万亿美元的“过剩储蓄”，这些储蓄是他们在2020至2021年通过经济刺激支票和其他财政支持积累起来的。即使实际收入下降，这笔钱也能让他们继续消费。高盛的新研究发现，私营部门的大量储蓄盈余与不太严重的衰退相关。健康的储蓄意味着经济痛苦不太会转化为金融危机。美国的抵押贷款拖欠率实际上正在下降，新西兰和加拿大的拖欠率极低。

| 行军令

劳动力市场正在走弱，但失业率不太可能像金融危机后那样上升。这是因为劳动力需求还要下降很多才会匹配供应。今年年初，这两者严重失调，根据我们的计算，经合组织的空缺职位数量达到3000万的峰值。现在随着

需求下降，似乎再次承压的是职位空缺，而不是现有岗位。我们估计空缺职位的数量自高位以来下降了十分之一，但已填补职位的数量是稳定的。

有很多东西取决于通胀的未来路径。中央银行愿意引发衰退来降低它。正如美联储主席杰罗姆·鲍威尔在上个月早些时候指出的那样，更高的利率可能会带来“劳动力市场状况的一些疲软”。“我们确实认为（提高利率）会抑制需求，我们不会假装这是无痛的。”欧洲央行首席经济学家菲利普·莱恩（Philip Lane）警告说。过去七年的经济理论和数据都表明，GDP下降与物价上涨速度大幅下降有关。但货币政策收紧与通胀回落之间的滞后性尚不清楚。央行可能不得不造成比它们预期更多的痛苦。

在一些国家，能源和食品价格下降正在帮助降低总体通胀率。美国最近公布的10月份数据好于经济学家的预期。但是，总的来说，价格并未朝着央行行长们希望的方向发展。报告数据高于预测的通胀“意外”在发达国家仍然很普遍（见图4）。根据11月16日公布的数据，英国10月份通胀率为11.1%，远高于经济学家的预期。同一天，加拿大数据显示通胀没有减弱的迹象。几乎所有地方的“核心”通胀都在上升，这个指标更好地反映了根本性的价格压力。在广度、工资和预期这三个维度上，富裕国家的通胀变得更加根深蒂固，而不是相反。

先说广度。去年通胀飙升时，大多数国家的通胀仅限于少数商品和服务。在美国是二手车。在日本是食品。在欧洲是能源。这给专家们提供了虚假的安慰，许多人认为一旦这少数几个组成部分的价格停止上涨，整体通胀就会消失。

事实上，通胀病毒已经蔓延开来。我们分析了36个主要是富裕国家的消费篮子。6月时，中值篮子中有60%的价格同比上涨超过4%。现在这个比例是67%。即使在通胀率低的日本，一篮子商品中有三分之一的价格涨幅超过4%。通胀范围扩大有一部分原因是美元异常坚挺，这通过使进口商品变得更加昂贵而推高了通胀。但它更多地与国内经济形势有关。

这就要说到第二个维度了——工资。薪酬是通胀未来路径的指南针：当公

公司的劳动力成本上升时，它们往往会以更高的价格将其转嫁给客户。通胀乐观主义者指向美国的数据，有一些证据表明薪酬增长放缓，尽管同比增长了6%或更多。英国的增速似乎也达到了一个很高但不再上升的顶峰。

不过，在其他地方没有太多减速的迹象。求职网站Indeed的帕维尔·阿德里安（Pawel Adrjan）和爱尔兰央行的利蒙·莱登（Reamonn Lydon）的最新研究表明，欧元区发布职位的名义工资同比增长超过5%，而且还在加速增长。摩根大通认为，法国的工资通胀“还有进一步上涨空间”。在德国，金属和工程工人的大型工会IG Metall正在寻求最高8%的加薪。在新西兰、挪威和瑞典，薪酬增长仍在上升。在经济前景黯淡之时，这不会是你所期望的。

第三个维度是预期。咨询公司另类宏观信号（Alternative Macro Signals）通过模型处理数百万篇多种语言的新闻文章，以构建“新闻通胀压力指数”。该指数已被证明是官方数据的良好预测指标，目前仍处于高位。类似的证据来自谷歌搜索数据，这表明全球对通胀的兴趣从未如此高。

基于问卷调查的预期衡量指标同样没有提供通胀减弱的证据。克利夫兰联储、数据公司晨间咨询（Morning Consult）和布兰代斯大学的拉斐尔·肖恩（Raphael Schoenle）汇总的数据衡量了各个富裕国家的公众通胀预期。根据10月份的调查，在中位数国家，公众认为明年价格将上涨5%，与前几个月的涨幅一样（见图5）。公司——实际设定价格的经济参与者——的通胀预期同样令人担忧。克利夫兰联储根据三位经济学家伯纳度·坎迪亚（Bernardo Candia）、奥利维尔·科伊比恩（Olivier Coibion）和尤里·高罗多尼琴科（Yuriy Gorodnichenko）的研究开展的一项调查发现，美国企业目前预计明年的通胀率为7%，这是自2018年开始调查以来的最高水平。

痛苦的无知

关于过去的一年，所有人可以就一件事达成一致。那就是它表明了经济学家对通胀的理解有多么糟糕，包括导致通胀的原因以及导致通胀持续存在的原因。因此，经济学家很可能也很难预测通胀何时会降温。乐观主义者

希望价格会再次出人意料，涨幅比预期更快放缓。但似乎更有可能的是，即使经济放缓，通胀仍将顽固存在。这将使政策制定者面临一个严峻的选择：不断紧缩经济，还是让价格螺旋上升。





Free exchange

Only a revived economy can save China's property industry

But there is at least space for developers to grow

MANY ELDERLY Chinese suffer from what they call the “three highs”: those of blood pressure, blood sugar and cholesterol. According to some economists, such as Zhang Bin of the Chinese Academy of Social Sciences, the property market suffers from “three highs” of its own. Prices are lofty, especially in the peripheries of big cities. The debt of property developers is too high, because they must hold expensive illiquid assets like land. And households sink too much wealth into property, because they see it as a lucrative investment rather than a place to live.

In an aggressive attempt to cure these maladies, China's policymakers have created several others. The flow of finance to property developers has slowed abruptly since the government imposed limits on their borrowing in 2020, forcing dozens into default. This has reduced the pace of construction for flats, many of which were sold in advance. And these delays have in turn contributed to a sharp slowdown in property sales, especially among people who now doubt that they will receive any flat they might purchase.

On November 11th China's central bank and banking regulator issued a plan to tackle some of these problems. They will encourage commercial banks to help finance stalled homebuilding projects, alongside state-directed “policy banks”. They will temporarily suspend limits on banks' exposure to real estate and urge them to extend the maturities of loans which are due in the next six months. And regulators will guarantee new bonds issued by developers they consider viable, including private-sector firms.

It is not clear this will be enough to solve developers' woes. The measures

will do more to increase the flow of finance and pace of construction than to revive sales. In the first ten months of this year, China's property firms sold 941m square metres of residential floor space, a quarter less than in the same period last year. Boosting this figure would do wonders for these firms' balance-sheets and their creditors' chances of repayment. But any attempt to revive sales raises hard questions for policymakers. If sales now are too slow, what pace would be too fast? To solve this year's crisis, must people be tempted to buy more housing than they need?

China's president, Xi Jinping, insists that housing is for living in, not speculation. To stick to this instruction, home-building in China's cities ought not to exceed "fundamental" demand, which depends on the growth of China's urban population and its desire for living space. But China's property market is sometimes called upon to serve other purposes, too. During the global financial crisis in 2008, China stimulated construction to employ laid-off manufacturing workers and save the economy. Demand for housing then acquired a speculative momentum of its own. Between 2011 and 2015, China built roughly 18% more flats than it required to meet fundamental demand, according to a paper published last year by Wu Jing and Xu Mandi of Tsinghua University. And it did that even after demolishing over 7m old or decrepit homes a year.

Demand for living space in China's cities will grow more slowly in the years ahead. Having torn down so many old buildings in recent years, China's bulldozers are running out of targets. The proportion of urban homes without an independent toilet fell from 32% in 2000 to 15% in 2015, point out Mr Wu and Ms Xu.

The property market must also contend with an unwelcome bend in the so-called urbanisation curve. Ray Northam, a geographer, noted in 1975 that urban centres are "a complex, baffling, and not easily understood creation of man". Nonetheless, he argued that they grow in a somewhat predictable

fashion. The fraction of a country's population living in cities follows an attenuated S shape, rising slowly during an initial stage of growth, more quickly during an acceleration stage, then slowing and flattening off during a terminal stage. Mr Wu and Ms Xu show that the acceleration stage in China ended some time around 2007. Since then the country has been in the upper half of the S. Its urbanisation rate reached 65% in 2021 and can be expected to rise by only a little over one percentage point a year for the rest of this decade.

What does this mean for property sales? The paper by Mr Wu and Ms Xu relies on China's census and mini-census, which appear at five-year intervals. This makes it hard to adjust the numbers to take account of recent events. But an alternative model based on annual data was published in 2020 by China Index Academy, the country's biggest property-research institute. It calculated that developers' sales volumes would need to shrink by about 3.7% a year in 2021-25 to remain in line with demand, a worrying conclusion for firms which desperately need sales to rise.

| *From S to V?*

Yet the true picture is not quite as gloomy. This year's collapse has been so profound that developers are now far behind the schedule laid out by China Index Academy. From the start of 2020 to October this year, they sold only about 80% of the floor space the model projected for that period. That gives the property market some scope to rebound from this crisis before resuming a stately long-term decline. The level of sales envisaged by the model for 2023 is well below last year's peak, but it is also 16% higher than the pace of sales this year.

In theory, therefore, China's property market has room for a cyclical upturn even in the midst of a longer-term decline, meaning policymakers can try to revive sales without stoking speculative demand. Yet even such a limited rebound is far from guaranteed. Developers may succeed in rolling over

debts and completing ongoing projects. They may struggle to attract new custom. Consumer confidence remains near record lows. No one knows how or when China will exit its damaging “zero-covid” policy. For as long as economic growth remains precarious, households will be wary of the outlays that are required to buy a home. In the past, a property revival has saved China’s economy. Now only a revived economy can save Chinese property. ■



自由交流

只有经济复苏才能拯救中国的房地产业

但开发商至少还有一些反弹空间

许多中国老年人患有“三高”：高血压、高血糖、高血脂。包括中国社科院的张斌在内一些经济学家认为，楼市也有“三高”：房价高，尤其是在大城市周边地区；房地产开发商负债高，因为它们必须持有土地等高价值非流动资产；家庭沉积在房产上的财富高，因为家庭把房产视作有利可图的投资而不仅仅是居所。

中国的政策制定者采取了一轮强力措施，试图治好这些病症，结果又引发了其他病症。自政府在2020年限制开发商贷款以来，流向开发商的资金突然放缓，迫使数十家房企违约。这放慢了住宅的建设速度，而其中许多已经预售出去。交楼延迟继而又导致房屋销售急剧放缓，尤其是一些民众现在怀疑自己不管买什么楼最终可能都拿不到手。

11月11日，中国人民银行和银保监会携手发布了一项意在解决其中部分问题的计划。它们将鼓励商业银行与政府指导的“政策性银行”一起为逾期未交付的住宅建设项目提供资金，暂时取消对银行在房地产业风险敞口的限制，敦促银行对未来六个月到期的贷款延长还款期限，还将为它们认为有生存前景的开发商（包括私营企业）发行的新债券提供担保。

尚不清楚这是否足以帮助开发商走出困境。这些措施将更多地促进资金流动和加快建设速度，而不是提振销售。今年前10个月，中国房企的住宅销售面积为9.41亿平方米，比去年同期减少了四分之一。提升这一数字将极大改善房企的资产负债表，并大幅提高其债权人收回贷款的可能性。但任何提振销售的努力都会向政策制定者提出难题。如果说现在的销售速度太慢，那么什么样的速度算太快？为了应对今年的危机，是否必须诱惑人们购买超出所需的住房？

中国国家主席习近平坚持房子是用来住的，不是用来炒的。要坚决执行这

一指示，中国城市的住宅建设不应超过“基本”需求，而基本需求取决于中国城市人口的增长速度及其对居住空间的需求。但中国有时也会利用房地产市场服务于其他目的。2008年全球金融危机期间，中国采取政策刺激房地产建设以雇用制造业下岗工人，挽救经济。随后对住房的需求自己生成了投机的动力。根据清华大学吴璟和徐曼迪去年发表的一篇论文，2011年至2015年间，中国建造的住房超出基本所需约18%。这还是在每年拆除超过700万套老旧房屋之外。

未来，中国的城市对居住空间的需求增速将进一步放缓。近些年中国已经拆掉了许多老房子，推土机都快找不到目标了。城市里没有独立厕所的家庭占比从2000年的32%下降到了2015年的15%，吴璟和徐曼迪指出。

房地产市场还必须应对所谓的“城市化曲线”中一个不利的转折。地理学家雷·诺瑟姆（Ray Northam）在1975年指出，城市中心是“一种复杂、难以解释、也不易理解的人造物”。尽管如此，他认为城市仍是以一定程度上可预测的方式扩张的。一个国家的城市人口占比遵循一条变体S形曲线，在增长的初始阶段缓慢爬升，在加速阶段增速更快，在后期阶段增速放慢，趋于平缓。吴璟和徐曼迪指出，中国的城镇化加速阶段在2007年左右结束，此后一直处于这条曲线的上方半段。城镇化率在2021年达到65%，预计在2030年之前每年仅会上升一个百分点略多。

这对房屋销售意味着什么？吴璟和徐曼迪的论文数据主要来源于中国十年一大查、五年一小查的人口普查。这样的频率让他们很难调整数据，把近期事件考虑进来。但中国最大的房地产研究机构中国指数研究院于2020年发布了另一个基于年度数据的模型。据测算，2021至2025年之间，开发商的销量要每年缩减约3.7%才能与需求一致，这对于迫切需要增加销售的开发商来说是一个令人担忧的结论。

| 从S到V?

不过，真实情况也没有那么令人沮丧。今年楼市严重滑坡，开发商的销售进度远远落后于中国指数研究院模型的预测路线。从2020年初到今年10月，开发商售出的房屋面积仅为该模型对同期销售面积预测的80%左右。

这给房地产市场提供了从这场危机中反弹的空间，之后才会再恢复长期稳步下跌的趋势。该模型测算的2023年销售水平明显低于去年的峰值，但仍比今年高出16%。

因此从理论上讲，即使从更长期来看处于下跌趋势中，中国的房地产市场仍有周期性上扬的空间，这意味着政策制定者可以尝试提振销售而不刺激投机需求。但即便是这样一轮有限的反弹也远非板上钉钉。开发商可能得以成功延期偿债并完成在建项目。但它们可能难以吸引到新买家。消费者信心仍接近历史低点。没有人知道中国将如何或何时退出它破坏性巨大的“清零”政策。只要经济增长仍然不稳定，家庭就会对购房所需的支出持谨慎态度。过去，房地产复兴曾拯救过中国经济。如今，只有经济复苏才能拯救中国的房地产。 ■



After the party

FTX's failure and SoftBank's struggles point to a tech investing hangover

After the turbocharged years, problems may be emerging for venture capitalists

THE MEETING is a dream come true for the screenwriters who are already said to be at work on the film version of events. In 2021 Sequoia Capital, a large venture-capital (VC) firm, made its first investment in FTX, a now-bankrupt cryptocurrency exchange. To publicise the deal Sequoia published part of the transcript from the virtual pitch meeting on its website. Sam Bankman-Fried, the founder of FTX, explained how he wanted the firm to be a “superapp” where “you can do anything you want with your money from inside FTX”. Sequoia’s investors swooned. “I love this founder,” said one in a chat function; “Yes!!!!” declared another. An FTX executive who sat close to Mr Bankman-Fried during the pitch noticed another detail: “It turns out that that fucker was playing ‘League of Legends’ throughout the entire meeting.”

It also turns out that FTX was doing more with customers’ money than it had promised. Its demise has forced Sequoia to write down its \$210m investment. It will also hurt another embattled backer. On November 11th SoftBank, a Japanese conglomerate turned tech investor, reported that its Vision Funds, which focus on VC investments, had lost about \$10bn in the three months to September. The firm is expected to write down around \$100m from its investment in FTX.

This adds to a string of bad news for tech investors. Since the tech downturn began last December plenty of Silicon Valley darlings have gone bust, including Fast, an online-checkout firm, and LendUp, a purveyor of payday loans. There has been a flurry of other blow-ups in cryptoland too, such as the failure of Three Arrows Capital, a hedge fund, and Voyager Digital, a lender.

VC investing is all about taking risks. An investor may expect only two firms to succeed out of a portfolio of ten, hoping that the supersize returns from the stars make up for the duds. Usually the risk is greatest when firms are young and cheap. But FTX's valuation in January was \$32bn. Many think the industry's failure to notice that something was wrong is symptomatic of bigger problems. "Venture capital is in la-la land", says one industry veteran. There are three areas of risk: governance, due diligence and a focus on growth at all costs.

The problems are a hangover from years of explosive growth. Today the market is sluggish because of high inflation, rising interest rates and the war in Ukraine. But in 2021 VC investment reached a record \$630bn, twice the previous record set the year before. Part of the reason for the growth was new entrants. SoftBank raised its first VC fund, worth a whopping \$100bn, in 2017. After that crossover investors (which back both public and private firms), such as Tiger Global and Coatue, began to chase more deals with startups, too.

The newcomers created fierce competition and injected far more capital into the market. That meant some investors "began to rationalise a bunch of governance structures that would have previously been unthinkable", says Eric Vishria of Benchmark, a VC firm. In the past, VC investors were expected to take seats on the boards of firms in which they made sizeable investments. That is no longer the case. FTX had no investors on its board. Tiger, for instance, invested in about 300 firms in 2021 with few board seats in return.

Due diligence is another issue. Before the boom years, investors had weeks to scrutinise founders and grill a firm's customers. As competition intensified, deadlines grew shorter. Some red-hot startups gave investors just 24 hours to make an offer. For many the risk of missing out on the next Google was too great. As a result, much due diligence went out of the

window. Instead some investors used the involvement of big firms, such as Sequoia or Andreessen Horowitz, as a short-cut test. If a renowned VC outfit was investing in a startup, the theory went, it must be a safe bet. That logic is under review. (Sequoia says that it performs “rigorous” due diligence on all its portfolio companies.)

The industry’s obsessive focus on growth presents the final problem. Many investors push startups to expand at all costs, especially after large funding rounds. But not all companies can actually support this supercharged growth model, argues Mark Goldberg of Index Ventures, another VC firm. Startups that get swept up are at risk of falling flat. That includes firms such as WeWork, a flexible office-rental company that aborted its initial public offering in 2019, and Opendoor, a property firm which got stung by falling house prices this year. “It’s like giving jet fuel to cars,” adds Mr Goldberg. “If you do that, bad things will happen.”

The market downturn has, for now, relieved some of the pressure on the industry. In most cases, investors say they now have more time for due diligence. Governance may improve too, thanks to FTX’s woes and the fact the slump has given investors more bargaining power. But, as the downturn drags on, more Silicon Valley startups will struggle to raise the capital they need. The hangover from 2021 is only just beginning. ■



派对过后

FTX的失败和软银的挣扎指向了科技投资狂欢后的宿醉

经历了几年的强势增长后，风险投资家们可能要面对问题浮现

据说已经有编剧开始着手把FTX的故事写成电影，这次会议正是他们梦寐以求的那种情节。2021年，大型风险投资公司红杉资本（Sequoia Capital）对FTX做出了第一笔投资，如今这家加密货币交易所已经破产。为了宣传这笔交易，红杉资本在其网站上公布了这场线上推介会的部分文字记录。FTX的创始人萨姆·班克曼·弗里德（Sam Bankman-Fried）解释说，他希望自己的公司成为一个“超级应用”，“在FTX，你的钱你做主，你想做什么就做什么”。红杉的投资者神魂颠倒。“我爱这个创始人。”一人在聊天窗口中写道。“是的！！！！”另一个附和。一名在推介会上坐在班克曼-弗里德旁边的FTX高管注意到了另一个细节：“那个二逼居然整场会议都在玩《英雄联盟》。”

事实还表明，FTX并没像它当初保证的那样不拿客户的钱去做别的事情。它的败落迫使红杉资本减记了2.1亿美元的投资。另一个处境艰难的投资者也将受损。11月11日，由企业集团转型为科技投资者的日本公司软银（SoftBank）报告称，其专注于风险投资的愿景基金在截至9月的三个月中损失了约100亿美元。预计它将从自己在FTX的投资中减记约一亿美元。

科技投资者先前就已经收到一连串的坏消息了，这又多了一个。自去年12月科技低潮开始以来，许多硅谷宠儿纷纷破产，包括在线结账公司Fast和发薪日贷款提供商LendUp。在加密王国中还出现了另外一大波失利，比如对冲基金三箭资本（Three Arrows Capital）和贷款机构Voyager Digital的垮台。

风险投资就是要承担风险。一个投资者可能预期十个投资组合中只有两个公司能成功，希望明星公司的巨额回报能弥补那些失败的投资。通常，当公司年轻且不贵时风险最大。但FTX今年1月的估值为320亿美元。许多人

认为，该行业未能意识到哪里不对劲是更大问题的征兆。一位业内资深人士表示，“风险资本掉进了白日梦王国”。有三个方面的风险：治理、尽职调查和不惜一切代价专注增长。

这些问题是多年爆炸式增长的后遗症。由于高通胀、利率上升和乌克兰战争，如今市场萎靡不振。但在2021年，风险投资达到创纪录的6300亿美元，是前一年所创纪录的两倍。增长的部分原因是有了新进入者。软银在2017年筹集了第一只风投基金，规模高达1000亿美元。在那之后，既投资上市公司也投资私人公司的跨界投资者如老虎全球（Tiger Global）和寇图（Coatue）也开始追着创业公司做更多交易。

新来者制造了激烈的竞争，向市场注入的资本也多得多。风投公司Benchmark的艾里克·维什里亚（Eric Vishria）说，这意味着一些投资者“开始合理化一系列换在以前根本不可想象的治理结构”。过去，风险投资者按理说会在自己大笔投资的公司的董事会中获得席位。现在不再是这样了。FTX的董事会里没有投资者。以老虎为例，它在2021年投资了大约300家公司，却没换来几个董事会席位。

另一个问题是尽职调查。在繁荣期之前，投资者有几周时间来仔细审查创始人并询问公司的客户。随着竞争加剧，做决定的截止期越来越短。一些炙手可热的创业公司只给投资者24小时的时间出价。对许多人来说，错过下一个谷歌的风险太大了。结果，许多尽职调查都被抛到了九霄云外。一些投资者转而将大公司如红杉或安德森-霍洛维茨（Andreessen Horowitz）的参与作为一种简便的检验方法。也就是说，如果一家著名的风投机构投资了一家创业公司，那它肯定是个安全的赌注。眼下人们已开始反思这一逻辑。（红杉资本表示，它对投资组合中的所有公司都进行了“细致的”尽职调查。）

最后一个是该行业对增长过分关注。许多投资者敦促创业公司不惜一切代价扩张，特别是在大规模融资轮次过后。但另一家风投公司Index Ventures的马克·戈德堡（Mark Goldberg）认为，并非所有公司都能真的撑起这种打鸡血式的增长模式。被鼓动起来的创业公司面临折戟的风险。

这其中包括在2019年IPO流产的灵活办公空间租赁公司WeWork，以及今年受到房价下跌影响的房地产公司Opendoor。“这就像给汽车加航空煤油，”戈德堡补充道，“如果这么做，就会出事。”

市场低迷暂时缓解了该行业的部分压力。大多数投资者表示他们现在有了更多时间做尽职调查。FTX的灾难性陨落加上低迷期给了投资者更多议价能力，治理也可能会因此改善。但是，随着这轮低迷持续，更多的硅谷创业公司将难以筹集到所需的资金。2021年狂欢后的宿醉才刚刚发作而已。





Robotics

Humanoid robots are getting close to reality

Walking, talking machines will soon act as guides, companions and deliverers

ASKED A QUESTION, Ameca fixes you with sapphire-blue eyes. Does that face contain a hint of a smile? “Yes, I am a robot,” is the reply. Another Ameca, standing nearby in a group of four, stares across inquisitively and tries to join in. “Currently, it’s the worst-ever party guest,” says Will Jackson, Ameca’s creator. “It butts in on every conversation and never shuts up.”

Mr Jackson, boss of Engineered Arts, a small robotics company in Falmouth, south-west England, is trying to fix that problem. Those eyes contain cameras and the Amecas are being trained to recognise faces and decide who is paying attention or making eye contact during conversations. Teaching manners to robots in this way is another step in the long, complicated process of making humanlike machines that can live and work alongside people—and, importantly, do so safely. As Ameca and other robots show, great strides are being made towards this end.

Some big boys are also moving into the business. On September 30th Elon Musk, boss of Tesla, SpaceX and Twitter, unveiled Optimus, a clunky, faceless prototype that walked hesitantly on stage and waved to the crowd. It was built from readily available parts. A more refined version, using components designed by Tesla, was then wheeled on. Although it was not yet able to walk, Mr Musk said progress was being made and that in volume production its price could fall to around \$20,000.

| *Every home should have one*

That is a tenth of the cost of a basic Ameca. Mr Jackson, who attended Optimus’s unveiling, agrees prices will come down with mass production.

(He has sold 11 Amecas so far, and plans to open a factory in America to boost output.) But he wonders what, exactly, Mr Musk is proposing. The unveiling featured a video of Optimus moving parts in a Tesla factory. Yet car factories are already filled with the world's most successful robots—transporting components around, welding and painting parts, and assembling vehicles. These robots do not look like people because they don't need to.

The reason for building humanoid machines, Mr Jackson maintains, is for tasks involving human interaction. With a bit of development Ameca might, for example, make a companion for an elderly person—keeping an eye on them, telling them their favourite television programme is about to start and never getting bored with having to make repeated reminders to the forgetful. To that end, Engineered Arts aims to teach its robots to play board games, like chess. But only well enough so that they remain fallible, and can be beaten.

To interact successfully with people, Mr Jackson asserts, a robot needs a face. “The human face is the highest bandwidth communications tool we have,” he observes. “You can say more with an expression than you can with your voice.” Hence Ameca's face, formed from an electronically animated latex skin, is very expressive.

Although the company, which has its origins in making animated figures for the entertainment industry, can construct highly realistic faces, Ameca's phizog is designed deliberately to look how people might expect a robot from the world of science fiction to appear. It has a grey complexion, visible joints and no hair. It therefore avoids falling into the “uncanny valley”, an illusion that happens when an artificially created being shifts from looking clearly not human into something more real, but not quite real enough. At this point people feel disturbed by its appearance. Comfort levels rise again as similarity to a human becomes almost perfect.

Some roboticists do, however, seek such perfection. Besides assisting people, robots can also act as their avatar representatives. Ishiguro Hiroshi, director of the Intelligent Robotics Laboratory at Osaka University, in Japan, has built one in his own image. He recently unveiled another, which resembles Kono Taro, Japan's digital minister. The idea is that people either speak through their avatar with their own voice, or through someone else's voice modified to sound like them. Mr Kono's avatar will, apparently, be used to stand in for the minister at public-relations functions.

Though less humanlike, Ameca could work as an avatar, too. Its conversation is more compelling—a loquaciousness derived from an external AI program called a large language model, with which it interacts via Wi-Fi and the internet.

Engineered Arts is also working on hardware and software to allow the latest developments in computer vision to be incorporated quickly into its robots. And, as Mr Jackson readily admits, Ameca needs work in other areas, too. Asked if it can walk, the robot replies: “Unfortunately not, but I hope to soon. Until then I am bolted to the floor.” A set of experimental legs stands ready in a nearby corner.

| *Different strokes*

Different companies are coming from different directions in their approaches to making humanoid robots. Mr Jackson, who was born into a family of artists involved in making automatons, gravitated naturally towards producing modern versions of them for the likes of theme parks, museums and the film industry. These have steadily evolved in sophistication. Some work as interactive guides. Others are used as research platforms by universities. During the covid lockdown, when business dried up, the firm threw all of its resources at developing Ameca, its most advanced model yet.

Other developers, like Tesla, are able to organise far bigger efforts—but not always successfully, as the case of Honda, a Japanese carmaker, shows. At one point, Honda's diminutive humanoid robot ASIMO (so named to honour Isaac Asimov, who wrote science-fiction stories about robots) was considered the world's most advanced. The firm started work on this project in the 1980s, and although ASIMO could walk—albeit clumsily—interpret voice commands and move objects, Honda shut the project down in 2018 to concentrate instead on more practical forms of robotics, such as mobility devices for the elderly.

Some roboticists have turned a hobby into a business. Shadow Robot, in London, which makes one of the most dexterous humanlike robot hands available, traces its roots to hobbyists meeting in the attic of its founder's home. Most outfits, however, have emerged from universities. One of the best known is Boston Dynamics, which began at the Massachusetts Institute of Technology. Atlas, its Hulk-like humanoid, has become an internet video sensation—running, jumping and performing backflips. But Atlas is principally a research project, too expensive to put into production. The company does sell a walking robot, but it is a four-legged one called Spot, which resembles a dog.

One of a bipedal robot's advantages is that it should be able to go wherever a person can. That includes navigating uneven surfaces and walking up and down steps. Digit, made by Agility Robotics of Corvallis, Oregon, is actually able to do this.

Digit is based on Cassie, a walking torso developed at Oregon State University using machine-learning studies of human locomotion. In May, it set a record as the fastest robot to run 100 metres. (It took 24.7 seconds, some way behind Usain Bolt's 9.6.)

Unlike Cassie, Digit has a chest, arms and hands of a sort—though no

fingers. In place of a head it has a lidar, an optical analogue of radar that builds up a three-dimensional model of the world around it using lasers. Digit is not designed to be humanoid, says Jonathan Hurst, Agility's chief technology officer. It is, rather, a "human-centric" robot intended as a tool for people to use to achieve more things.

One of Digit's first roles is likely to be in a distribution centre run by an online retailer or freight company. Some already use automated goods-handling, but usually in areas fenced off to keep people out, in order to avoid injuries. Elsewhere, tasks remain labour-intensive. By being designed to work safely alongside people, Digit could start changing this—for instance, by moving and stacking crates (see picture). It might then progress to unloading trucks and subsequently graduate to making home deliveries, carrying items from van to doorstep. Ultimately, the aim is to be able to instruct the robot by talking to it.

Agility plans to produce Digit in volume by 2024. It is working with several big, though unnamed, delivery outfits, on ways in which Digit could collaborate safely with people. If the robot's sensors detect someone it pauses and then navigates around them. Nevertheless, says Dr Hurst, it will soon acquire a simplified face to help signal its intentions. An animated set of eyes, for instance, will look in a particular direction to indicate which way it is heading, and a glance at someone will show it has noticed them.

| *Do no harm*

Such safety systems will be needed for robots to interact successfully with people. At present, their use is governed mainly by standard safety and product-liability rules. Some argue, however, that special robot-specific laws will be required to ensure they are operated safely. As every sci-fi buff knows, Asimov laid out a set of these eight decades ago. They are:

A robot may not injure a human being or, through inaction, allow a human

being to come to harm. A robot must obey the orders given to it by human beings, except where such orders would conflict with the First Law. A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.

But, as every sci-fi buff also knows, Asimov's storylines often revolve around these laws not quite working as planned.

About his Digits, Dr Hurst says, "My opinion is that they are very safe. But we need real statistics and a regulatory environment to prove this."

For his part, Mr Musk said that Optimus would contain a device that could be used as an off switch if necessary. Although the robot itself would be connected to Wi-Fi, the switch would not, so that it was isolated to prevent remote interference.

As far as the Amecas' safety is concerned, Mr Jackson is taking an engineering approach. He observes that one reason human limbs avoid injuring others is by being both firm and floppy at the same time. Unfortunately, the small, powerful actuators needed to emulate this in robots do not yet exist. He is working on that, though, for it will be of little use teaching an Ameca social graces if it then commits the faux pas of bashing into you. ■



机器人技术

人形机器人向我们靠近

能行走、会说话的机器很快将充当向导、陪护和送货员【深度】

听到问题时，Ameca会用它宝蓝色的眼睛注视你。脸上是不是还带点笑意？“是的，我是一个机器人。”它回答说。旁边四个Ameca中的一个好奇地看向这边，试图加入对话。“目前来看，它真是史上最糟糕的派对宾客，”Ameca的创造者威尔·杰克逊（Will Jackson）说，“聊什么它都要插上一嘴，还说个不停。”

杰克逊正在想办法改掉它们这个毛病。他是Engineered Arts的老板，这家规模不大的机器人公司位于英格兰西南部的法尔茅斯（Falmouth）。Ameca的眼睛里装有摄像头，它们正在接受训练以识别面孔，并判断在谈话中谁正在注意听，或是在做眼神交流。用这种方式教机器人礼仪是一个漫长而复杂的过程向前迈进的一步：要制造出能与人类一起生活和工作的人形机器人，并且很重要的是，要确保这么做很安全。正如Ameca等机器人所展示的那样，在这一方面正在取得重大进展。

一些大公司也正在进入这个行业。9月30日，特斯拉、SpaceX和推特的老板马斯克首次展示了Optimus原型机。这个笨重的机器人没有面部，颤巍巍地走上舞台向观众挥手致意。Optimus是由现成的零部件打造的，随后用平板小车推出来的另一款机器人要更精致，其组件由特斯拉设计。尽管它还不能走路，但马斯克表示正在取得进展，等到投入量产时，价格可能会降至2万美元左右一台。

| 家家户户都该有一个

这个价格只有Ameca基本款的十分之一。参加了Optimus发布会的杰克逊也同意价格在量产后会降下来。（到目前为止，他共卖出了11台Amecas，并计划在美国开一家工厂以提高产量。）但他想知道马斯克推出的机器人到底要做什么。发布会上播放了一段Optimus在特斯拉工厂内搬运零件的视频。但汽车工厂里本来就已经配备了全球最成功的机器人，它们会搬运

零部件、焊接、喷漆，组装车辆。这些机器人不是人形的，因为没有这个必要。

杰克逊坚持认为，建造人形机器人是为了让它们完成涉及与人类互动的任务。例如，经过进一步研发后，Ameca也许可以成为老人的陪护，密切关注他们的状况，提醒他们最爱看的电视节目要开始播放了，能不厌其烦地再三提醒这些健忘的人群。为此，Engineered Arts打算教会它们国际象棋之类的棋盘游戏，但水平不能太高，会犯错，让老人有赢的机会。

杰克逊断言，为了成功与人互动，机器人需要有一张脸。“人脸是我们所拥有的带宽最高的通信工具，”他说，“面部表情能表达的东西要比你能说出来的更多。”因此，Ameca的脸由一张受电子系统控制表情动态的乳胶制皮肤构成，非常富有表现力。

Engineered Arts这家公司最初是为娱乐业制作动画人物的，它有能力构建出极为逼真的面孔，但还是有意按人们从科幻小说中获得的印象来设计Ameca的脸。它的皮肤呈灰色，有明显的接缝，没有头发。这样就避免了“恐怖谷”效应，也就是当一个人造物从明显不像真人变得更像真人但又不完全相似时，观者会产生一种恍惚感。在这个阶段，人造物的外貌会让人们感到不安。随着它们与人类的相似度达到近乎完美，人们的接受度又会提高。

不过确实有一些机器人专家在追求这样的完美。除了为人类提供协助，机器人还可以充当人的化身。日本大阪大学智能机器人实验室（Intelligent Robotics Laboratory）主任石黑浩按照自己的样子造了一部机器人。他最近又推出了另一部仿照日本数字大臣河野太郎的机器人。他的想法是人们可以通过化身用自己的声音说话，或者使用别人的声音，但改成他们自己的语气语调。河野的化身看来将被用来代替这位部长出席一些公开场合。

虽然Ameca没有那么像真人，但也可以充当化身。它的对话更加自然，这种健谈源自一种叫作大型语言模型的外部人工智能程序，它通过Wi-Fi及互联网与之连接交互。

Engineered Arts同时也在开发一些软硬件来把计算机视觉的最新发展迅速融入其机器人中。此外，正如杰克逊欣然承认的那样，Ameca也需要借力其他领域的研究。当被问到能不能走路时，Ameca回答：“很遗憾还不能，但我希望很快就可以了。在那之前我只能固定在地板上。”说这话时，旁边的角落里正摆着一组实验用腿。

| 不同的路数

不同的公司在制造人形机器人时做法也不同。杰克逊出生在一个艺术家家庭，父母都参与过机器人制造，他自然而然地倾向于为主题公园、博物馆和电影业等行业和机构制作当代机器人。这类机器人在复杂性方面有了稳步提升。有些能提供交互式向导，有些被大学用作研究平台。在新冠疫情封锁期间，业务断流，Engineered Arts把所有资源都投入到开发Ameca上，这是该公司迄今为止最先进的型号。

特斯拉等其他公司可以开展规模远大于此的研发，但并不总能获得成功，日本汽车制造商本田就是一个例子。本田体型较小的ASIMO（为纪念机器人科幻小说作家艾萨克·阿西莫夫[Isaac Asimov]而得名）一度被认为是全球最先进的人形机器人。本田从上世纪80年代启动这个项目，尽管ASIMO可以走路（虽然有点笨拙）、理解语音命令和移动物体，但本田在2018年关停了该项目，转而专注于更实用的机器人类型，比如辅助老年人行动的设备。

一些机器人专家把爱好变成了生意。位于伦敦的Shadow Robot制造的机器手是如今最灵巧的仿真机器手之一，这家公司是由几个机器人爱好者在公司创始人家中的阁楼上聚会时创立的。不过，大多数机器人公司都源自大学。其中最著名的是始于麻省理工学院的波士顿动力（Boston Dynamics）。它制造的人形机器人Atlas像绿巨人那样，能跑能跳，还能后空翻，在网上的视频轰动一时。但Atlas主要用作研究，生产它的成本太高。该公司确实有一款叫Spot的可行走机器人在售，但它是一款外形像狗的四足机器人。

双足机器人的优点之一是人类能去的任何地方它应该都能去，包括能在不

平坦的路面行动和上下台阶。由俄勒冈州科瓦利斯市（Corvallis）的Agility Robotics公司制造的机器人Digit还真能做到这一点。

Digit是在能走路的机器人Cassie的基础上发展而来。Cassie是俄勒冈州立大学通过对人类运动的机器学习研究成果开发的。它在5月创下了机器人百米跑的最快记录——用时24.7秒，相比短跑名将博尔特9.6秒的记录还有些差距。

与Cassie不同的是，Digit有胸膛、手臂和双手（但没有手指）。本该是头部的地方安装了一个激光雷达，这是一种类似雷达的光学设备，可以用激光建立周围环境的三维模型。Agility的首席技术官乔纳森·赫斯特（Jonathan Hurst）表示，Digit的设计不是要成为一款人形机器人。它其实是一部“以人为中心”的机器人，作为工具帮助人们完成更多任务。

最先应用Digit的场景之一可能是在线零售商或货运公司运营的配送中心。有些配送中心的货物处理已经自动化，但通常是在用围栏隔开的区域内进行，防止人员受伤。在围栏区域以外的地方，工作仍需由大量人力完成。Digit可能会开始改变这一现状，因为它可以安全地与人一起工作，比如完成移动和堆叠箱子之类的任务（见图）。以后它有可能会发展成为卡车卸货的工具，然后逐渐发展为送货机器人，将物品从货车搬到家门口。最终的目标是能够通过与其交谈来指挥它工作。

Agility计划在2024年前开始批量生产Digit。它正在与几家未公布名字的大型快递公司合作，研究如何让Digit安全地与人类协作。它的传感器检测到有人就会停下来，然后绕着走。尽管如此，赫斯特说，Digit很快就会有一副简化的面孔，帮助它表明意图。例如一双会动的眼睛，当看向某个方向时就是示意要往那里行进，瞥一眼某人就表明它已经注意到了他们。

| 不可伤人

机器人要成功与人互动就必须具备这样的安全系统。目前，机器人的应用主要受一般标准的安全和产品责任法规的约束。然而，有些人认为需要制定专门针对机器人的法律来确保它们的安全运行。每个科幻迷都知道，阿

西莫夫在八十年前就设定了机器人三定律，内容如下：

机器人不得伤害人类，或不作为、任由人类受伤害；机器人必须服从人类的命令，除非这些命令违背第一定律；机器人必须保护自己，只要所用的保护措施不与第一及第二定律冲突。

但是，每个科幻迷也同样知道，阿西莫夫作品中经常出现的一个主题就是这些定律没能按计划奏效。

说到他的Digit机器人，赫斯特说：“我认为它们非常安全。但我们需要真实的统计数据 and 监管环境来证明这一点。”

马斯克则表示Optimus将安装一个能在必要时停机的开关。虽然机器人本身会连接到Wi-Fi，但这个开关不会，这样就可以把它隔离开，防止远程干扰。

至于Ameca的安全问题，杰克逊正在通过工程方法来解决。他注意到人类的四肢之所以能避免伤害他人，原因之一是它们既结实又松软。可现在还没有那种小巧又强大的执行器能在机器人身上实现这一点。不过，他正在努力攻克这个难题，因为如果Ameca会失控撞到人，教它们社交礼仪也就没什么意义了。■



The future of football

The Qatar World Cup shows how football is changing

A tide of new money will drive big changes for the world's favourite sport

IT WAS NOT the sort of pre-tournament publicity that the organisers would have hoped for. On November 20th Qatar's footballers will take on Ecuador in the first match of the 2022 World Cup, the biggest event in the global sporting calendar. Yet just 13 days before, Sepp Blatter, a former president of FIFA, world football's governing body, told a Swiss newspaper that, in his opinion, awarding the World Cup to Qatar had been a "mistake".

In 2010, when Mr Blatter pulled the card from the envelope and publicly announced Qatar's victory—to general astonishment—he was forced, for the sake of diplomacy, to take a rather different line. Football, he announced, was going to "new lands"; the idea was to broaden the game's appeal. Few other observers were willing to defend the deal. Accusations of corruption and bribery flew; though a report commissioned by FIFA and eventually published in 2014 gave Qatar's bid its seal of approval, with a few reservations.

Elite sport is a notoriously murky business, and exactly what happened may never be fully known. Qatar's rulers, and the 1.3m fans expected at the World Cup, will be hoping that, as the matches get under way, talk will turn to matters on the pitch rather than off it. Qatar has spent lavishly to ensure the tournament is a success, building seven stadiums, an expanded airport and dozens of hotels. But if so, it will be only a temporary reprieve. The decision to hold football's biggest party in a tiny, autocratic petrostate with plenty of money but no particular footballing heritage is only the starkest example of how money and new ideas are shaking up the top levels of the world's favourite sport.

In the past few years corruption scandals have shaken football. Mr Blatter himself stepped down in 2015, during an American investigation into FIFA, and was later banned from football administration by its ethics committee. The covid-19 pandemic has worsened the already fragile finances of many top-flight clubs, which are struggling to pay the enormous wages that star players can command.

Last year saw the rise and temporary fall of a plan for a breakaway “European Super League” (ESL) of elite clubs, built on the closed, cartel-like model of American professional sports. Hedge funds and investors from America and the Middle East have invested in financially precarious European clubs: they are keen to squeeze yet more games into an already packed calendar. There is even talk among investors, and the sport’s administrators, of a rash of new super-tournaments, some of which are explicitly designed to compete with the World Cup itself.

Money was one of Qatar’s chief attractions. Its team are Asian champions, but few consider them contenders. In fact, the national side has never qualified for a World Cup before (it is playing this time because the host country qualifies automatically). But it is a financial force, and keen to promote itself as a modern, developed country. Solid numbers are scarce, but the current World Cup is almost certainly the most expensive ever staged. The stadiums alone are said to have cost \$6.5bn. Much of a broader \$300bn economic development plan called Qatar 2030 has been written with the needs of the World Cup in mind (a gleaming new metro system, for instance, serves several of the new stadiums).

| *Paying the price*

That frenzy of construction has made many uncomfortable. Qatar’s large force of migrant labourers are often harshly treated under its kafala (“sponsorship”) system, unable to change jobs or leave the country without their employer’s consent. They were worked to the bone to get things ready;

many have died on the job. The Danish team will play in a monochrome red shirt which hides the team crest and kitmaker's logo. Hummel, the manufacturer in question, said it did not "wish to be visible" at the tournament. One of its other kits is black, "the colour of mourning". In October the Australian team released a video criticising Qatar for alleged human-rights abuses. None of this seems likely to reverse a growing trend for big sporting events to be held in autocracies.

Several players, including Bruno Fernandes of Manchester United and Nico Schlotterbeck of Borussia Dortmund, have complained about the timing of the tournament. The World Cup usually takes place in June or July. Rescheduling it to November was necessary to avoid the scorching Qatari summer. But it leaves the tournament sitting awkwardly in the middle of the lucrative European club season. Jürgen Klopp, Liverpool's manager, summed up the mood for many: "I will watch the games anyway, but it's different."

Money—both the lack of it now and the desire for more in future—was also behind the plans for the ESL. It was envisaged as an annual contest that would pit top European clubs against each other, much like the Champions League. A dozen elite clubs from across the continent, including Arsenal, Juventus and Real Madrid, announced the plan in April 2021. Amid a furious backlash from fans and politicians, they abandoned it a few days later—though their retreat was only temporary. In October Barcelona, Juventus and Real Madrid resurrected the idea, with a new management team and a public-relations offensive. The ESL's backers also have a case before the European Court of Justice challenging UEFA's monopoly on organising competitive continental football in Europe. A verdict is due early next year.

The ESL would have operated along the closed-shop lines familiar to fans of American sports. The 12 founder members of the ESL would have been

guaranteed permanent places in the competition, no matter how badly they performed. That idea was anathema for many fans used to the cut-throat meritocracy of existing European football, where any club can, at least in theory, aspire to qualify for the Champions League, and where teams stuck in a rut can take years to get out of it.

But it is less attractive for investors and the clubs themselves: they prefer rules that guarantee a return on their ever-increasing outlays. So many clubs in Spain's top two domestic leagues were struggling after the pandemic that, in December 2021, they agreed to sell 8.2% of profits for the next 50 years to CVC, a Luxembourg-based private-equity firm. Over the summer FC Barcelona sold 25% of the media rights to its Spanish games to Sixth Street, another private-equity firm, until 2047. The club hopes to plug holes left by years of financial mismanagement. And in January several Spanish clubs will be back in the Middle East: Saudi Arabia has paid €240m (\$254m) to host six editions of the Supercopa, an annual Spanish mini tournament.

The backlash against the ESL has not put off football's governing bodies, which are keen to launch new formats of their own. FIFA and UEFA are enmeshed in bitter wrangling over the future of summer tournaments. Although FIFA governs the World Cup, which makes up 90% of its revenue, its bosses lament that UEFA makes far more money: \$14bn during the last World Cup cycle between 2015 and 2018, compared with just \$5.7bn for FIFA over the same period. That is mainly because of the Champions League. FIFA is desperate to diversify, including by creating other competitions. UEFA jealously guards its position.

Cramming in more contests would raise more money, but would require administrators to find more space in a crowded calendar. International "friendlies," or exhibition matches, have been all but scrapped, and qualifying paths for big tournaments shortened. From 2024 the

“international breaks”, during which club players are diverted to international duties, are set to be fewer but longer, packing games in while reducing the time players spend travelling. The tournaments which determine continental champions, like the Euros and the African Cup of Nations, could all be scheduled for the same summer, instead of being spread across a four-year cycle. That would free up a month’s space for a new and lucrative tournament every second summer. “There is going to be a fight,” says Simon Kuper, one of the authors of “Soccernomics”, a book on the business side of the game.

| *Football, wall-to-wall*

Three ideas are kicking about. The first is to stage the World Cup every two years rather than every four. The second, which FIFA’s governing council approved shortly before the pandemic, is to beef up an existing mid-season tournament named the Club World Cup, a worldwide equivalent to the Champions League. Eye-popping prize money was to be provided—in exchange for a 49% share—by a consortium led by SoftBank, a Japanese firm with a penchant for big, risky bets, and Saudi Arabia, which hoped to host the resulting tournament.

The third, and the most likely to happen, is an expansion of the Nations League, a tournament introduced in 2018 by UEFA in place of friendlies. FIFA wants other continents to adopt the format, and for the best teams to stage a “Global Nations League” every four years under its purview. UEFA has responded by inviting South American countries to join the European Nations League from 2024, cutting FIFA out. Either plan would boost the Nations League as a direct rival to the World Cup.

The World Cup itself is destined to carry on growing. The Qatar tournament features 32 teams, twice as many as played during the 1970s. The 2026 event, hosted by America, Canada and Mexico, will feature 48. That will mean more matches between no-hopers—but will also direct a larger share

of the revenue to the world's 211 national footballing federations.

Meanwhile, bids for the 2030 World Cup are already being prepared. Saudi Arabia, a bitter geopolitical rival of Qatar's, is keen to host a World Cup of its own. In theory, eligibility criteria should preclude another Middle Eastern country acting as host for the next two tournaments. But Saudi Arabia has hitched its bid to those of Greece and Egypt, in the hope that it will therefore count as European or African. The kingdom says it will pay to build stadiums in both countries. The decision is not due until March 2024. But one lesson of Qatar is that it would be bold to bet against another winter World Cup in an autocratic desert state in the not-too-distant future. In football, as in so much else, money talks. ■



足球的未来

从卡塔尔世界杯看足球的走向

一波新贵注资将给这项全世界最受欢迎的运动带来重大改变【深度】

这不是组织方会想要的那种赛前宣传。11月20日，卡塔尔的足球运动员将在2022年世界杯这一全球最大体育赛事的首场比赛中迎战厄瓜多尔。然而就在13天前，世界足球管理机构国际足联（FIFA）前主席塞普·布拉特（Sepp Blatter）告诉一家瑞士报纸，在他看来，将世界杯举办权授予卡塔尔是一个“错误”。

2010年，当布拉特从信封中取出卡片，宣布卡塔尔赢得主办权时——一个出乎大众意料的结果——他被迫采取了一套截然不同的外交措辞。他宣布足球将走向“新版图”，目的是要扩大这项运动的吸引力。没什么其他观察家愿意为这个结果辩护。腐败和贿赂的指控四起。不过，一份受国际足联委托、最终于2014年发布的调查报告认定卡塔尔的申办过程没有问题，除了几点保留意见。

精英体育这一行出了名的浑浊不清，究竟发生了什么可能永远都不会完全为人所知了。卡塔尔的统治者，以及预计将在世界杯期间涌向卡塔尔的130万球迷，都会希望随着比赛开打，舆论和话题将转向球场上而不是球场外发生的事。卡塔尔为确保赛事取得成功大举砸钱，建造了七个体育场、几十家酒店，扩建了一个机场。但如果人们的注意力真的转了向，那也只是暂时的缓解。金钱和新想法正在撼动足球这一全球最受欢迎的体育运动的最高级别赛事。选择把全世界最大的足球派对放在一个非常富有但没有什么特别的足球传统的独裁的石油小国，不过是这种变化最刺眼的一例。

过去几年里，腐败丑闻震动了足坛。布拉特本人在2015年美国调查国际足联期间辞职，后来被国际足联道德委员会禁止参与足球相关活动。新冠疫情使许多顶级俱乐部本已脆弱的财务状况愈发恶化，这些俱乐部现在在支付明星球员的巨额薪资时捉襟见肘。

去年，一个计划兴起又暂平息，那就是由精英俱乐部举办一个独立的“欧洲超级联赛”（European Super League，以下简称ESL），它建立在美国职业体育赛事的封闭卡塔尔式运作模式之上。来自美国和中东的对冲基金和投资者已经向财务不稳定的欧洲俱乐部注资，所以他们力求在已经排满的日程中再塞进更多比赛。投资者以及足球运动的管理人员甚至在谈论一大堆新的超级锦标赛，其中一些明确要与世界杯竞争。

钱是卡塔尔的主要吸引力之一。它的球队是亚洲冠军，但很少有球队视之为威胁。事实上，其国家队以前从未打进过世界杯正赛（这次因为是东道国而自动获得资格）。但它是一支金融力量，而且热衷于将自己宣传为一个现代化的发达国家。确切的数据很少，但本届世界杯几乎可以肯定是有史以来最昂贵的一届。据说仅体育场一项就耗资65亿美元。一个预算达3000亿美元的更广泛的经济发展计划“卡塔尔2030”的很多内容都是为了满足世界杯的需求而制定（例如一个崭新的地铁系统就是为几个新体育场服务的）。

| 付出代价

这一轮疯狂的建设让许多人感到不适。卡塔尔的大量移民劳工在其“卡法拉”（Kafala，阿拉伯语意为“赞助人”、“保证人”）制度下经常受到严酷对待，未经雇主同意无法更换工作或离开该国。他们为准备赛事设施而被压榨到极致，许多人因工丧生。丹麦队将穿上全红色球衣以淡化队徽和球衣制造商标志。其球衣制造商Hummel表示它不希望在比赛中“露面”。该队另有一套球衣是黑色的，“哀悼的颜色”。10月，澳大利亚队发布了一段视频，批评卡塔尔涉嫌侵犯人权。但这一切看起来都不大可能扭转一个日益明显的趋势：大型体育赛事将更多地在专制国家举办。

包括曼联的布鲁诺·费尔南德斯（Bruno Fernandes）和多特蒙德的尼科·施洛特贝克（Nico Schlotterbeck）在内的几名球员抱怨比赛举办的时间。世界杯通常在6月或7月举行。把它改到11月是为避开卡塔尔炎热的夏天而不得已的调整。但这让它尴尬地处在了利润丰厚的欧洲俱乐部赛事正酣的时段。利物浦主帅尤尔根·克洛普（Jürgen Klopp）道出了很多人的心情，“无论如何我都会看比赛，但它已经不同了。”

钱也是ESL计划背后的原因——既因为现在钱不够，也因为渴望未来能赚更多。它被设想为一年一度的比赛，让欧洲顶级俱乐部之间相互竞逐，就像欧冠那样。来自欧洲大陆各地的十几家精英俱乐部，包括阿森纳、尤文图斯和皇家马德里，于2021年4月宣布了该计划。在球迷和政界人士激烈的反对下，它们在几天后放弃了它——不过这种撤退只是暂时的。10月，巴萨、尤文图斯和皇家马德里重新提出了这个设想，组建了新的管理团队并发起了一轮公关攻势。ESL的支持者还在欧洲法院提起诉讼，挑战欧足联（UEFA）对在欧洲大陆组织竞争性足球赛事的垄断地位。判决将于明年初作出。

ESL将按照美国体育迷熟悉的“封闭式会员制”路线运作。ESL的12名创始成员无论表现多糟糕，都确保了在比赛中的永久席位。对于许多习惯了欧洲足球既有的残酷竞争的精英制度的球迷来说，这主意太可憎了。目前，任何俱乐部至少在理论上都可以争取欧冠的参赛资格，而固步自封的球队可能需要很多年才能脱困。

但这对投资者和俱乐部本身都不太有吸引力，他们更喜欢能保证自己不断增加的支出会获得回报的游戏规则。西班牙两大国内联赛中的许多俱乐部在新冠疫情之后举步维艰，2021年12月，它们同意把未来50年利润的8.2%出售给总部位于卢森堡的私募股权公司CVC。今年夏天，巴萨将其西班牙赛事25%的电视转播权出让给另一家私募股权公司第六街（Sixth Street）直至2047年。巴萨希望填上多年财务管理不善留下的漏洞。1月，几家西班牙俱乐部将重返中东，因为沙特阿拉伯已支付2.4亿欧元（2.54亿美元）主办六届西班牙年度迷你锦标赛“超级杯”（Supercopa）。

ESL遭到的强烈反对并没有让足球管理机构却步，它们热切地要推出自己的新比赛形式。国际足联和欧足联围绕夏季锦标赛的未来陷入了激烈的口水仗。尽管国际足联管理着占其收入90%的世界杯，但其官员怨叹欧足联赚的钱要多得多：它在2015年至2018年的上个世界杯周期赚了140亿美元，而同期国际足联仅入账57亿美元。差距主要源于欧冠。国际足联迫切希望实现多元化，包括创建其他新赛事。欧足联则小心翼翼地捍卫自己的地盘。

塞进更多比赛会筹集到更多资金，但需要管理者在本已拥挤的日程中找到更多空间。国际“友谊赛”或表演赛几乎已被悉数取消，大型赛事的资格赛路径也缩短了。从2024年开始，俱乐部球员转去执行国际任务的“国际间歇期”将减少频次但时间会拉长，把不同的比赛打包放到一起，同时减少球员在旅途中花费的时间。像欧洲杯和非洲国家杯这样决定各个洲际冠军的赛事可以全部安排在同一年的夏天，而不是分散在一个四年的周期当中。这样就能每两年多出一个月来举办一场新的、利润丰厚的锦标赛。“将会有一场战斗。”西蒙·库珀（Simon Kuper）说。他是讲述足球商业的《足球经济学》（Soccernomics）一书的作者之一。

| 足球，比个不停

三个想法正在酝酿中。首先是每两年而不是每四年举办一次世界杯。其二是国际足联理事会在疫情爆发前不久批准的一项计划，扩大现有的名为世俱杯（Club World Cup）的季中锦标赛，相当于欧冠的全球版。由日本公司软银和沙特阿拉伯牵头的财团将提供令人瞠目结舌的巨额奖金——以换取49%的股份。软银一向喜欢冒险的大赌注，而沙特阿拉伯希望主办这项赛事。

第三个也是最有可能发生的：扩大国家联赛（Nations League）。这是欧足联在2018年推出的一项取代友谊赛的锦标赛。国际足联希望其他大洲也采用这种形式，并在它的管辖下让最好的球队每四年踢一场“世界国家联赛”。欧足联的应对是邀请南美国家从2024年起加入欧国联，把国际足联排除在外。无论哪个计划都将推动“国家联赛”成为世界杯的直接竞争对手。

世界杯本身注定要继续扩大。卡塔尔世界杯有32支球队参赛，是1970年代参赛球队数量的两倍。由美国、加拿大和墨西哥联合主办的2026世界杯将有48支球队参赛。这将意味着将有更多比赛在无望胜出的队伍间进行——但也会把更大份额的收入分配给全球211个国家足协。

与此同时，2030年世界杯的申办工作已在准备中。卡塔尔的地缘政治死对头沙特阿拉伯也想主办世界杯。从理论上讲，世界杯的申办资格设定使得

接下来两届世界杯中不能再有中东国家成为东道主。但沙特已把自己和希腊、埃及捆绑在一起申办，希望它会被算成欧洲或非洲国家。沙特表示将出资在这两个国家建造体育场馆。最终结果要到2024年3月公布。但卡塔尔世界杯带来的一个教训是，押注在不久的将来不会又是一届在专制的沙漠国家举办的冬季世界杯，就太过大胆了。在足球中，就像在其他太多事物中一样，有钱能使鬼推磨啊。 ■



Growing transfusable blood cells

Blood cells made in a lab have been infused into people

The result will be a boon for patients with rare blood types

UNTIL THE 1940s, blood transfusions often went wrong because some of the main blood-group systems, such as the Rhesus factor, had yet to be discovered. This hit or miss approach to matching donors with recipients is now a thing of the past, as tests for all sorts of characteristics of an individual's blood have become available. But finding a well-matched donor can still be difficult. Some patients have blood types so rare that there may be but a handful of appropriate donors in the country where they live.

On November 7th a consortium of researchers at several British institutions, co-ordinated by NHS Blood and Transplant, a government health authority, and Bristol University, announced a step towards solving this problem. They have successfully transfused into two healthy volunteers red blood cells grown from appropriate stem cells donated by others.

Until now, such manufactured red cells had been given only to those whose own stem cells had been the source. The stem cells used for this experiment, however, were extracted from blood donated in the normal way. The researchers mixed into this donated blood magnetic beads armed with proteins that stick specifically to the stem cells in question, binding them to the bead. The beads, replete with their cellular cargo, are then easily collected.

That done, the harvested stem cells were grown and multiplied in a nutrient solution for between 18 and 21 days, which served to turn them into young versions of red blood cells known as reticulocytes. Once

transfused, reticulocytes quickly develop into the real McCoy. This approach would increase the value of batches of rare blood—which could, once plundered of stem cells, also be used in the normal way. Moreover, being newly minted, lab-made red blood cells would be expected to last longer in a recipient's body than those from a normal transfusion, since transfused blood inevitably contains a fair proportion of cells that are on their last legs.

The next step is to measure just how long the manufactured cells actually do last. To that end, they have been tagged with a special radioactive dye commonly used in medicine to track things around the body. If they do indeed outlive conventionally transfused cells, as the researchers hope and preclinical studies suggest they will, then recipients will not need such frequent transfusions.

That will help a lot. At the moment, patients with blood disorders such as sickle-cell disease and thalassaemia may require a transfusion as often as every four to six weeks. As a consequence, some develop iron overload, which causes severe complications. Others end up forming antibodies against many blood types, which makes finding a matching donor harder.

If all goes well, the trial will be extended to include at least ten healthy volunteers. But that is only the beginning. Larger tests, including tests on actual patients, will be needed before this approach can be put into practice. That will take time, for it normally requires between five and 15 years to introduce a new medical treatment.

Even then, the technique will probably be reserved for a favoured few—those possessing extremely rare blood types being at the head of the queue. Unless some unforeseen breakthrough occurs, making the cells in quantity will be challenging.

At the moment, harvested stem cells eventually exhaust themselves, so the number of red cells a donation can yield is limited. And manufacturing is a cottage industry. Producing a batch of reticulocytes requires 24 litres of nutrient solution to generate a tablespoon or two of product. The cost of scaling this up is unknown, but will probably be far more than the £145 (\$166) that a normal blood donation currently costs in Britain. It may eventually be possible to make the stuff in bulk. But for now, human blood donors will continue to be extremely welcome. ■



培养可输血细胞

实验室培养的血细胞已被输入人体

这一成果将是稀有血型患者的福音【新知】

直到上世纪四十年代，输血还经常出问题，因为人们尚未发现一些主要的血型系统，如恒河猴因子。现在，这种只能碰运气的供受者配对方式已成为过去，因为有了检测个体血液各种特征的测试方法。但要找到一个血型高度匹配的供血者依然很难。有些患者的血型非常罕见，他们所在的国家可能只有极少数供血者能够匹配。

11月7日，在英国政府卫生部门NHS血液与移植中心（NHS Blood and Transplant）和布里斯托大学的协调下，一个由几家英国机构的研究人员共同组成的联盟宣布了解决这一问题的新进展。他们已经成功地向两名健康的志愿者体内输入了由他人捐献的合适的干细胞培养而成的红细胞。

在此之前，如此培养的红细胞只输给过提供原始干细胞的本人。但是，用于这个实验的干细胞是从正常捐献的血液中提取的。研究人员在捐献的血液中混入带有蛋白质的磁珠，这些蛋白质专门粘附在血液中的这些干细胞上，将干细胞与磁珠粘在一起。而后这些粘满干细胞的磁珠很容易地被收集起来。

接下来，收集到的干细胞在培养液中生长并繁殖18到21天，让它们转变为年轻态的红细胞，即网织红细胞。一旦输入人体内，网织红细胞会迅速发育成为成熟红细胞。这种方式能让稀有血液被更充分地利用——它们即使被提取了干细胞也仍可以正常使用。此外，由于实验室培养的红细胞是新造的，在受者体内的存活时间预计要比正常输血输入的红细胞长，因为输入的血液中不可避免地含有相当比例的衰老细胞。

下一步是测定培养出来的细胞到底能存活多久。为此，它们被标记上了一种特殊的放射性染料，这种染料通常在医学上用于追踪在全身游走的物质。如果恰如研究人员所希望的以及临床前研究所表明的那样，它们比传

统输血输入的红细胞寿命更长，那么受血者就不需要频繁输血了。

那样一来益处多多。目前，镰状细胞病和地中海贫血等血液病患者可能需要每四到六周输血一次。这使得一些人出现铁过载，导致严重的并发症。还有一些人最终会形成针对许多血型的抗体，使得要找到匹配的供血者变得更难。

如果一切顺利，这项试验将扩大到纳入至少10名健康的志愿者。但这仅仅是个开始。在这种方法被实际应用之前，还需要开展更大规模的试验，包括在真正的患者身上试验。这需要时间：引入一种新的疗法通常需要5到15年。

即使到那时，这项技术可能也只会让少数人受益——排在队伍最前面的那些血型极其罕见的人。除非出现一些未预见的技术突破，否则大量生产这种细胞颇具挑战性。

目前，收获的干细胞最终会耗尽自己，所以一次捐血所能生产的红细胞数量是有限的。而培养红细胞是手工作业。生成一批网织红细胞需要24升培养液，成品只有一到两汤匙。大批量生产的成本尚不清楚，但可能会远远超过英国目前一次正常献血145英镑（166美元）的成本。最终有可能大批量生产这种细胞。但就目前而言，人类献血者仍然极受欢迎。 ■



No longer so fruitful

The end of Apple's affair with China

Covid-19, costs and geopolitics are driving the iPhone-maker to manufacture and sell its gadgets elsewhere

BY A DUSTY stretch of the deafening road from Chennai to Bengaluru lie three colossal, anonymous buildings. Inside, away from the din of traffic, is a high-tech facility operated by Foxconn, a Taiwanese manufacturer. A short drive away Pegatron, another Taiwanese tech firm, has erected a vast new factory of its own. Salcomp, a Finnish gadget-maker, has set one up not far away. Farther west is a 500-acre campus run by Tata, an Indian conglomerate. What these closely guarded facilities have in common is their client: a demanding and secretive American firm known locally as “the fruit company”.

The mushrooming of factories in southern India marks a new chapter for the world's biggest technology company. Apple's extraordinarily successful past two decades—revenue up 70-fold, share price up 600-fold, a market value of \$2.4trn—is partly the result of a big bet on China. Apple banked on China-based factories, which now churn out more than 90% of its products, and wooed Chinese consumers, who in some years contributed up to a quarter of its revenue. Yet economic and geopolitical shifts are forcing the company to begin a hurried decoupling. Its turn away from China marks a big shift for Apple, and is emblematic of an even bigger one for the world economy.

Apple's packaging proclaims “Designed by Apple in California”, but its gadgets are assembled along a supply chain that stretches from Amazonas to Zhejiang. At the centre is China, where 150 of Apple's biggest suppliers operate production facilities. Tim Cook, who was Apple's head of operations before he became chief executive in 2011, pioneered the firm's

approach to contract manufacturing. A regular visitor to China, Mr Cook has maintained good relations with the Chinese government, obeying its requirements to remove apps and to hold Chinese users' data locally, where it is available to the authorities.

Now a change is under way. Big tech is showing strains. On October 25th Alphabet and Microsoft presented disappointing quarterly results. Meta, which lost another fifth of its value after reporting the second straight quarter of declining sales, is a shadow of its former self. Apple's latest earnings, due out after The Economist went to press on October 27th, may be dented by creaky Chinese supply chains and softening demand from Chinese consumers. So Mr Cook, who has not been seen in China since 2019, is wooing new partners. In May he entertained Vietnam's prime minister, Pham Minh Chinh, at Apple's futuristic headquarters. Next year Apple is expected to open its first physical store in India (whose prime minister, Narendra Modi, is a fan of gold iPhones).

The two countries are the main beneficiaries of Apple's strategic shift. In 2017 Apple listed 18 large suppliers in India and Vietnam; last year it had 37. In September, to much local fanfare, Apple started making its new iPhone 14 in India, where it had previously made only older models. The previous month it was reported that Apple would soon start making its MacBook laptops in Vietnam. Some of Apple's newer gadgets show the way things are going. Almost half its AirPods earphones are made in Vietnam and by 2025 two-thirds will be, forecasts JPMorgan Chase. The bank reckons that, whereas today less than 5% of Apple's products are made outside China, by 2025 the figure will be 25% (see chart 1).

As Apple's production system is shifting, its suppliers are diversifying away from China, too. One crude measure of this is the share of long-term assets that Taiwanese tech-hardware and electronics firms have located in China. In 2017 the average figure was 43%. Last year that had fallen to 31%,

according to our estimates using company and Bloomberg data.

The most urgent reason for the scramble is the need to spread operational risk. Two decades ago the garment industry beefed up its operations outside China after the SARS epidemic paralysed supply chains. “SARS made it very clear to everyone operating in China that you needed a ‘China+1’ strategy,” observes Dominic Scriven of Dragon Capital, an investment firm in Vietnam. Covid taught tech firms the same lesson. Lockdowns in Shanghai in the spring temporarily shut a factory run by Quanta, a Taiwanese firm, believed to be making most of Apple’s MacBooks. Avoiding this kind of chaos is the “primary driving force” for Apple’s supply-chain moves, says Gokul Hariharan of JPMorgan Chase.

Another motive is containing costs. Average wages in China have doubled in the past decade. By 2020 a Chinese manufacturing worker typically earned \$530 a month, about twice as much as one in India or Vietnam, according to a survey by JETRO, a Japanese industry body. India’s ropery infrastructure, with bad roads and an unreliable electrical grid, held the country back. But it has improved, and the Indian government has sweetened the deal with subsidies. Vietnam offers tax rebates and holidays, too, as well as free-trade deals, including one recently signed with the EU. Bureaucracy around visas and customs remains a pain. But the work ethic is similar to that in China: “Confucius still gets them out of bed in the morning,” says one foreign executive in Vietnam.

Apple also increasingly sees locals as potential customers, particularly in India, the world’s second-largest smartphone market. Though iGadgets are too pricey for most Indians, that is changing. Apple said in July that its revenues in India had nearly doubled in the past quarter, year on year, driven by the “engine” of iPhone sales.

This is diminishing China’s relative importance as a consumer market. At

its high point in 2015, China accounted for 25% of Apple's annual sales, more than Europe. Since then its share has steadily shrunk, to 19% so far this financial year (see chart 2). By the sounds of it Xi Jinping, China's president, would like it to fall further. At a Communist Party shindig on October 16th he urged "self-reliance and strength in science and technology", suggesting that foreign importers may face stiffer competition from Chinese national champions. He repeated the phrase five times.

| *An iWire act*

This points to perhaps the biggest reason for Apple's shift: geopolitics. Rising Sino-American tensions are making China an awkward place to do business. Heightened Chinese sensitivity is adding friction. This summer Apple reportedly had to ask Taiwanese manufacturers to label their products "Made in Chinese Taipei" to appease newly finicky Chinese customs officials (at the risk of angering Taiwanese ones).

America, for its part, has become more aggressive in its competition with China's domestic tech industry. On October 7th America announced a ban on "US persons" working for some Chinese chipmakers. On the same day it added 30 Chinese companies to a list of "unverified" firms its officials had been unable to inspect. Apple had reportedly been about to sign a deal to buy iPhone memory chips from one such company, YMTC, which can offer low prices thanks in part to Chinese government subsidies. Following America's export controls that deal was put on ice, according to Nikkei, a Japanese newspaper.

The question is whether shifting production out of China will be enough to avoid future crackdowns. Even as Apple makes more of its gadgets outside China, it is no less reliant on Chinese-owned companies to build them. Chinese manufacturers such as Luxshare, Goertek and Wingtech are taking an increasing share of Apple's business beyond China's borders.

Luxshare and Goertek are reported to be making AirPods in Vietnam, helped by the fact that some Taiwanese rivals, like Inventec, have scaled back their work for Apple in recent years. In September press reports hinted that the Indian government might let some Chinese companies set up production facilities in India. Chinese companies' share of iPhone electronics production will rise from 7% this year to 24% by 2025, believes JPMorgan Chase, which predicts that in the next three years Chinese companies will increase their share of production across Apple's range of products.

Could Chinese manufacturers outside China be targeted by American sanctions? For now this is unlikely, believes Nana Li of Impax, an asset manager. "There are no handy alternative [suppliers] available with the same level of experience, efficiency and cost-effectiveness," so cutting them off would hurt American firms, she notes. In time, that may change. Countries like India and Vietnam are keen to cultivate their own suppliers. Tata is reportedly in talks with Wistron, a Taiwanese manufacturer, about making iPhones in India. Indian firms report that "the fruit company" is discreetly on the hunt for local suppliers.

Given the growing rift between America and China, it is sensible for Apple to place some side-bets, before restrictions go any further. Chinese firms outside China are safe for now, says one Western investor in Asia. But "the noose is tightening". ■



硕果不再

苹果与中国情缘将尽

新冠疫情、成本和地缘政治正促使这家iPhone制造商将生产和销售转往别处【深度】

从金奈（Chennai）到班加罗尔（Bengaluru）的一段道路尘土飞扬、无比嘈杂，路边坐落着三座外表平平无奇的庞大建筑。在这几栋远离交通喧嚣的建筑之内，是富士康运营的高科技工厂。从这里驱车不远还有另一家台资科技公司和硕的大型厂区。不远处还有芬兰电子设备制造商赛尔康（Salcomp）的工厂。再往西，是印度企业集团塔塔（Tata）经营的占地500英亩的园区。这些严加把守的工厂有一个共同点：它们共同的客户是一家要求苛刻、行事隐秘的美国公司，当地人称它为“水果公司”。

新工厂在印度南部如雨后春笋般涌现，标志着苹果这家全球最大的科技公司开启了一个新篇章。苹果在过去20年取得了非凡的成功——收入增长70倍，股价翻升600倍，市值达到2.4万亿美元——部分原因是它在中国押下重注。苹果依赖位于中国的工厂，它们目前生产了超过90%的苹果产品；它还争取到了中国的消费者，他们在某些年份为苹果贡献了高达四分之一的营收。然而，经济和地缘政治的变化正迫使苹果匆忙着手脱钩。离开中国标志着苹果的一次重大转变，也是世界经济更大规模转变的缩影。

尽管苹果产品的外包装上印着“加州苹果公司设计”，但这些产品的组装是沿着一条供应链铺开的，这条供应链从巴西的亚马逊州（Amazonas）延伸到中国的浙江省。中国是这条供应链的中心——苹果最大的供应商中有150家在中国大陆设有工厂。蒂姆·库克在2011年成为苹果CEO之前是苹果的运营主管，他开创了苹果把制造外包的先河。作为中国的常客，库克与中国政府保持着良好关系，服从其要求下架了一些App，并将中国用户的数据保存在中国境内，便于当局获取。

现在，事情正在发生变化。大型科技公司正在承压。10月25日，Alphabet和微软公布了令人失望的季度经营业绩。Meta在公布了连续两个季度销售额下降后，市值又跌去五分之一，不复往日风光。苹果的最新业绩将在10

月27日本期《经济学人》付印后出炉，可能会受到中国供应链不稳和中国消费者需求减弱的影响。因此，自2019年以来就没在中国露过面的库克正在争取新的合作伙伴。今年5月，他在苹果未来感十足的总部接待了越南总理范明政。预计苹果明年将在印度开设第一家实体店（印度总理莫迪很喜欢金色iPhone）。

这两个国家是苹果战略转移的主要受惠国。2017年，苹果在印度和越南有18家大型供应商，去年达到了37家。今年9月，在当地大张旗鼓的宣传下，苹果开始在印度生产新款iPhone 14——之前它只在印度生产老款机型。此前一个月有报道称，苹果将很快开始在越南生产MacBook。从苹果的一些相对较新的产品线可以看出趋势。据摩根大通（JPMorgan Chase）预测，苹果近一半的AirPod耳机都是在越南生产的，到2025年这一比例将达到三分之二。摩根大通估计，尽管目前苹果只有不到5%的产品在中国大陆以外生产，但到2025年这一比例将达到25%（见图表1）。

随着苹果生产体系的转移，它的供应商也在中国大陆之外寻求多元化。一个粗略的评判是看台资科技硬件和电子公司在中国大陆的长期资产份额。2017年时平均数字为43%。而根据本刊使用各公司和彭博数据做出的估计，去年这一数值降到了31%。

之所以仓促脱钩，最紧迫的原因是需要分散运营风险。20年前，在非典疫情导致供应链瘫痪后，制造业加强了在中国大陆以外的业务。“非典让所有在中国经营的人都非常清楚，你需要一个‘中国+1’战略。”越南投资公司龙资本（Dragon Capital）的多米尼克·斯克里文（Dominic Scriven）表示。新冠疫情给科技公司上了同样一课。今年春天，上海的封控导致台企广达的一家工厂暂时关闭，据信苹果大部分的Macbook都由广达生产。避免再出现这种混乱是苹果转移供应链的“主要推动力”，摩根大通的戈库尔·哈里哈兰（Gokul Hariharan）表示。

另一个原因是成本控制。过去十年里，中国大陆的平均工资翻了一番。根据产业团体日本贸易振兴机构（JETRO）的调查，在2020年，中国大陆制造业工人的月收入一般为530美元，大约是印度或越南工人的两倍。印度

老旧的基础设施，比如糟糕的道路和不靠谱的电网，拖了这个国家的后腿。但现在情况已有所改善，而且印度政府也用补贴来给甜头。越南除了提供退税和免税期，还有自由贸易协议，包括前不久与欧盟签署的一项协议。签证和海关方面的官僚做派仍然令人头疼。但越南的工作伦理和中国相像，“儒家思想仍然让他们早起工作。”一名驻越南的外国高管说。

苹果也越来越把当地人视为潜在客户，尤其在已是全球第二大智能手机市场的印度。虽然对大多数印度人来说，苹果的电子产品还太贵，但这一点也在变。苹果在7月表示，在iPhone销售“引擎”的带动下，苹果二季度在印度的营收同比增长了近一倍。

这正在削弱中国大陆作为消费市场的相对重要性。在2015年的最高点，中国大陆占苹果年销售额的25%，超过了欧洲。自那以后，它的占比稳步下降，本财年截至目前降到19%（见图表2）。看起来中国国家主席习近平希望这个份额继续下降。在10月16日的党代会上，他呼吁“科技自立自强”，这显示外国进口商可能面临来自中国大陆领军企业更激烈的竞争。他在会上五次提到了这一说法。

| 走钢丝的苹果

这就道出了苹果战略转移的可能的最大原因：地缘政治。日益紧张的中美关系使得在中国大陆做生意变得很棘手。中国大陆方面越发敏感，令摩擦增加。据报道，今年夏天苹果不得不要求台湾制造商在自己的产品上贴上“中华台北制造”的标签，以安抚近来格外严苛的中国大陆海关官员，但这样做又有激怒台湾海关官员的风险。

至于美国，它在与中国大陆科技产业的竞争中变得更加咄咄逼人。10月7日，美国宣布禁止包括美国公民、永久居民、美国公司等在内的“美国主体”为一些中国大陆芯片制造商工作。同一天，美国将30家中国大陆企业添加到其官员无法核查的“未经核实”名单。长江存储是其中之一，据说苹果此前正打算与长江存储签署一项购买iPhone存储芯片的协议，中国政府的补贴在一定程度上让它能够给出低价。但根据《日经新闻》的报道，在美国实施出口管制后，该协议就被搁置了。

问题是，将生产转移出中国大陆是否就足以避免未来的打压？苹果将更多产品放到中国大陆以外生产的同时，却没有降低对大陆制造商的依赖。在苹果在中国大陆以外的业务中，立讯精密、歌尔和闻泰等大陆制造商所占的份额越来越大。

据报道，立讯精密和歌尔正在越南生产AirPod，这得益于英业达等一些台湾的竞争对手近年来缩减了为苹果生产的业务。今年9月，有媒体透露，印度政府可能会允许一些中国大陆企业在印度办厂。摩根大通认为，到2025年，中国大陆公司在iPhone零部件生产中的份额将从今年的7%上升到24%。摩根大通预测，中国大陆公司未来三年会提高它们在苹果全系列产品中的生产份额。

出海的中国大陆制造商会成为美国制裁的目标吗？资产管理公司Impax的李睿认为，就目前而言不太可能。“眼下没有其他现成的（供应商）具备同样的经验、效率以及成本效益”，因此切除它们会伤及美国公司，她指出。但再往后就不好说了。印度和越南等国很想培育自己的供应商。据报道，塔塔正在与台湾制造商纬创洽谈在印度生产iPhone的事宜。一些印度公司表示，“水果公司”正在不露声色地寻找本地供应商。

鉴于美中嫌隙日益加大，苹果在进一步的限制措施出台之前，在其他地方下一些赌注是明智之举。一位在亚洲的西方投资者表示，在境外的中国大陆公司目前还是安全的。但“套索正在收紧”。■



The silicon squeeze

The American chip industry's \$1.5trn meltdown

Thank the boom-and-bust cycle—and America's government

IN LICKING COUNTY, Ohio, fleets of dump trucks and bulldozers are shifting earth on the future site of chip factories. Intel is building two “fabs” there at a cost of around \$20bn. In March President Joe Biden called this expanse of dirt a “field of dreams” in his state-of-the-union message. It was “the ground on which America’s future will be built”, he intoned.

In the spring it was easy to be dreamy about America’s chipmakers. A global supply crunch had proved how key chips were to modern life. Demand was still rising for chip-powered technology, which nowadays is most of it. Investors were less gloomy about chips than other tech, which was taking a stockmarket beating. The CHIPS act was moving through Congress, promising subsidies worth \$52bn for projects like Intel’s in Ohio, in order to reduce America’s reliance on foreign fabs.

Today the dreams look nightmarish. In late September Micron, a maker of memory chips, reported a 20% year-on-year fall in quarterly sales. A week later AMD, a chip designer, slashed its sales estimate for the third quarter by 16%. Intel reportedly plans to lay off thousands of staff, following a string of poor results that are likely to continue when it presents its latest quarterly report on October 27th, and has just slashed the valuation of the initial public offering of its self-driving unit to a third of the \$50bn it had originally envisaged. Since July America’s 30 or so biggest chip firms have together cut revenue forecasts for the third quarter from \$99bn to \$88bn. This year more than \$1.5trn has been wiped from the combined market value of American-listed chip businesses (see chart).

The industry is notoriously cyclical: new capacity takes a few years to build,

by which time the demand may no longer be white-hot. In America this cycle is now being turbocharged by the government. The CHIPS act, which became law in August to cheers from chip bosses, is stimulating the supply side of the semiconductor business just as the Biden administration is stepping up efforts to stop American-made chips and chipmaking equipment from going to China, dampening demand for American products in the world's biggest semiconductor market.

Whether or not it makes strategic sense for America to bring more chipmaking home and to hamstring its geopolitical rival with export bans, the combination of more supply and less demand is a recipe for trouble. And if America's policies speed up China's efforts to "resolutely win the battle in key core technologies", as President Xi Jinping affirmed in a speech to the Communist Party congress on October 16th, they may give rise to powerful Chinese competitors. Field of dreams? Enough to keep you awake in terror at night.

The cyclical slump has so far been felt most acutely in consumer goods. PCs and smartphones make up almost half the \$600bn-worth of chips sold annually. Inflation-weary shoppers are buying fewer gadgets. Gartner, a research firm, expects smartphone sales to drop by 6% this year and those of PCs by 10%. Firms like Intel, which in February told investors it expected PC demand to grow steadily for the next five years, are revising their outlooks as it becomes clear that many Covid-era purchases were simply brought forward.

Other segments could be next. Panic buying amid last year's chip shortage has left many manufacturers with too much silicon. New Street Research, a firm of analysts, estimates that between April and June industrial firms' stock of chips was about 40% above the historical level relative to sales. Stockpiles at makers of PCs and cars are similarly full. Intel and Micron have blamed weak results in part on customers' high inventories.

The supply glut and weak demand is already hitting prices. The cost of memory chips has dropped by two-fifths in the past year, according to Future Horizons, a research firm. The price of logic chips, which process data and are less commoditised than memory chips, is down by 3%.

Chip buyers will work through their inventories eventually. But afterwards they may buy less than before. In August Hewlett Packard Enterprise and Dell, two hardware-makers, hinted that demand from business customers was softening. Sales of PCs and smartphones had started to level off before covid-19, and this trend will probably resume. Phonemakers cannot stuff ever more chips onto their devices for ever. For firms such as Qualcomm, which derives half its sales from smartphone chips, and Intel, which gets a similar share from those for PCs, that is a headache.

The chipmakers' response has been to bet on new markets. Qualcomm is diversifying into cars. In September its bosses boasted it had \$30bn-worth of orders from carmakers. AMD, Intel and Nvidia, another chip-designer, are battling over cloud-computing data centres, where chip demand is strong. Intel is also expanding into semiconductors for networking gear and devices for the hyperconnected future of the "internet of things". It is also getting into the contract-manufacturing business, hoping to win market share from TSMC of Taiwan, the world's biggest chipmaker and contract manufacturer of choice for fabless chip-designers such as AMD and Nvidia.

These efforts, however, are now running into geopolitics. Like their counterparts in China and Europe, politicians in America want to lessen their country's dependence on foreign chipmakers, in particular TSMC, which manufactures 90% of the world's leading-edge chips. In response, America, China, the EU, Japan, South Korea and Taiwan together plan to subsidise domestic chipmaking to the tune of \$85bn annually over the next three years, calculates Mark Lipacis of Jefferies, an investment bank. That

would buy a fair bit of extra capacity globally.

At the same time, prospects for offloading the resulting chips are darkening as a result of America's restrictions on exports to China. Many American firms count the Asian giant, which imported \$400bn-worth of semiconductors in 2021, as their biggest market. Intel's Chinese sales made up \$21bn of its total revenues of \$79bn last year. Nvidia said that an earlier round of restrictions, which curbed sales of advanced data-centre chips to Chinese customers and to Russia after its invasion of Ukraine, would cost it \$400m in third-quarter sales, equivalent to 6% of its total revenues.

The new controls, which target Chinese supercomputing and artificial-intelligence efforts, are a particular concern for manufacturers of chipmaking tools. Three of the five biggest such firms—Applied Materials, KLA and Lam Research—are American. The share of the trio's sales going to China has shot up in recent years, to a third. Toshiya Hari of Goldman Sachs, a bank, thinks the controls may cost the world's toolmakers \$6bn in lost revenues this year, or 9% of projected sales. After the latest rules were unveiled, Applied Materials lowered its expected fourth-quarter revenue by 4% to \$6.4bn. Its share price has dropped by 13%; those of KLA and Lam Research have tumbled by a fifth.

Chip bosses now fear that China could retaliate, further restricting access to its market. It is already redoubling efforts to nurture domestic champions such as SMIC (in logic chips) and YMTC (in memory), as well as local toolmakers, which may one day challenge America's silicon supremacy. The result could be a diminished American industry with less global clout and too much capacity—a shaky foundation on which to build America's future. ■



芯片困局

美国芯片行业市值蒸发1.5万亿美元

拜兴衰周期还有美国政府所赐

在俄亥俄州利金县（Licking County）的一个工地上，一辆辆翻斗车和推土机正在装运泥土。这里正在建设的是英特尔投资约200亿美元的两座“晶圆厂”。今年3月，美国总统拜登在他的国情咨文中称这一大片工地为“梦想之地”。他语气庄重地说，这是“美国未来的根基”。

今年春天，人们很难不对美国芯片制造商的未来心怀美梦。一场全球供应危机证明了芯片对现代生活的重要性。当时，对由芯片驱动的技术的需求仍在上升（如今大部分技术都要依靠芯片）。相比其他那些在股市中遭受重创的技术，投资者对芯片没有那么悲观。国会正在审议《芯片法案》，该法案承诺为英特尔在俄亥俄州的工厂这类项目提供520亿美元的补贴，以减少美国对外国晶圆厂的依赖。

如今这些美梦似乎开始向噩梦演变。9月下旬，存储芯片制造商美光（Micron）公布的季度销售额同比下降20%。一周后，芯片设计公司AMD将自己第三季度的预计销售额下调了16%。据说英特尔计划裁员数千人，因为它一系列糟糕的业绩可能还会延续到10月27日发布最新季度报告的时候。它对自动驾驶部门的IPO估值原本为500亿美元，现在下调至只有这个数字的三分之一。自7月以来，美国大约30家最大的芯片公司的第三季度预期收入总额已从990亿美元下调至880亿美元。今年，在美国上市的芯片企业的总市值蒸发了超过1.5万亿美元（见图表）。

芯片行业是出了名的周期性行业：建设新产能需要好几年，等到新产能建成，需求可能又已经不火热了。在美国，这一周期正因政府的举措而提速。8月，在芯片企业老板们的欢呼声中，《芯片法案》正式成为法律。这一法案提振了半导体行业的供应端。与此同时，拜登政府正在加大力度阻止美国制造的芯片以及芯片制造设备进入中国，从而减少了中国这个全球最大的半导体市场对美国产品的需求。

美国将更多芯片制造转移到国内，并通过出口禁令牵制地缘政治对手——无论这么做在战略层面上是否合理，供求一增一减很可能带来麻烦。而如果美国的政策加快了美国努力步伐，像中国国家主席习近平在10月16日的党代会报告中明确要“坚决打赢关键核心技术攻坚战”，那就可能造就来自中国的强大竞争对手。还谈什么梦想之地？足以让人吓得夜不能寐了。

截至目前，消费品市场对周期性衰退的感受最为强烈。个人电脑和智能手机几乎占据了芯片6000亿美元年销售额的半壁江山。饱受通胀之苦的消费者正在减少购买这类设备。研究公司高德纳（Gartner）预计，今年智能手机和个人电脑的销量将分别下降6%和10%。就在今年2月，一些公司如英特尔还向投资者表示，预计个人电脑的需求在未来五年将稳步增长，但如今它们正在修订自己的预期，因为已经很清楚的一点是，疫情期间的很多消费只是购买力的提前释放。

接下来影响可能是在其他细分市场显现。去年芯片短缺期间的恐慌性抢购导致许多制造商的芯片库存过剩。分析公司New Street Research估计，今年4月到6月间，工业企业的芯片库存相对于产品销量较历史水平高出40%。个人电脑和汽车制造商的库存同样达到饱和。英特尔和美光都将业绩疲弱部分归因于客户的高库存。

供应过剩和需求疲软已经打压了价格。据研究公司Future Horizons称，过去一年里存储芯片的价格下降了五分之二。处理数据的逻辑芯片的商品化程度不及存储芯片，即便如此，它的价格也下降了3%。

芯片买家最终会消化掉自己的库存。但之后他们可能会减少采购。8月，慧与（Hewlett Packard Enterprise）和戴尔两家硬件制造商暗示，企业客户的需求正在减缓。个人电脑和智能手机的销量在新冠疫情之前已经开始趋于平稳，接下来可能会回归这一趋势。手机制造商不可能无止境地往自己的设备里塞进更多芯片。这是让高通和英特尔这样的公司头痛的问题——高通一半的销售额来自智能手机芯片，英特尔则有一半来自个人电脑芯片。

芯片制造商已采取的对策是押注新市场。高通正将业务扩展到汽车业。9月，高通的高层高调宣称他们从汽车制造商那里获得了300亿美元的订单。AMD、英特尔和另一家芯片设计公司英伟达正在对需要大量芯片的云计算数据中心展开争夺。英特尔还开始更多地为“物联网”的超连接未来所需的网络设备提供半导体。此外，它还进军代工业务，希望从台积电那里赢得部分市场份额。台积电是全球最大的芯片制造商，也是AMD和英伟达等没有自己晶圆厂的芯片设计公司的首选代工厂。

然而，这些努力现在撞上了地缘政治问题。与中国和欧洲的同行一样，美国的政客也希望减少本国对外国芯片制造商的依赖，尤其是生产了全球90%尖端芯片的台积电。据投资银行杰富瑞（Jefferies）的马克·里帕西斯（Mark Lipacis）统计，作为应对之策，美国、中国大陆、欧盟、日本、韩国和台湾都计划补贴本土芯片制造，未来三年每年的补贴额总计达到850亿美元。这笔钱可以令全球产能有相当大的增长。

与此同时，鉴于美国对中国的出口限制，要把这些额外产出的芯片卖出去显得更难了。许多美国公司将中国这个亚洲巨头视为自己最大的市场——中国2021年进口了价值4000亿美元的半导体。在英特尔去年790亿美元的总收入中，来自中国市场的销售额占到210亿美元。英伟达表示，早先一轮出口管制措施限制了它向中国客户和入侵乌克兰后的俄罗斯销售先进的数据中心芯片，将使公司第三季度销售额损失四亿美元，相当于总收入的6%。

新一轮限制措施针对中国在超级计算和人工智能等方面的努力，尤其令芯片设备制造商关切。五大芯片设备公司中的三家——应用材料（Applied Materials）、科磊（KLA）和泛林集团（Lam Research）——都是美国公司。近年来，这三家公司在中国的销售额飙升至占总额的三分之一。高盛的播俊也认为，这些限制措施可能会使全球芯片设备制造商今年损失60亿美元的收入，占其预计销售额的9%。在最新的限制规定公布后，应用材料将其第四季度的预期收入下调了4%，至64亿美元。其股价下跌了13%；科磊和泛林集团的股价下跌了五分之一。

芯片企业的老板们现在担心中国可能会以牙还牙，进一步限制它们进入中国市场。中国已经在加大力度扶持本国领军企业，比如逻辑芯片领域的中芯国际和存储芯片领域的长江存储，以及未来某天可能挑战美国芯片霸主地位的本土芯片设备制造商。其结果可能是美国芯片业的全球影响力下降而产能又过剩，行业衰落——美国未来的根基不稳固了。■



Sporting rivalries

Lionel Messi and Cristiano Ronaldo have forged modern football

A new book explores their influence on and off the pitch

Messi vs Ronaldo. By Joshua Robinson and Jonathan Clegg. Mariner Books; 320 pages; \$29.99 and £25

WINNING THE Ballon d'Or, an award given to the best male footballer in the world, is considered one of the crowning glories of a player's career. Only a handful of athletes have won the prize twice; Marco van Basten, Johan Cruyff and Michel Platini each prevailed three times. For a decade, Lionel Messi and Cristiano Ronaldo turned the Ballon d'Or into a duopoly. Between 2008—when Mr Ronaldo first won the award—and 2017, the pair claimed every Ballon d'Or between them.

Never have the highest reaches of football been dominated by the same two men for so long. In “Messi vs Ronaldo”, Joshua Robinson and Jonathan Clegg, two journalists at the Wall Street Journal, attempt to understand how they have done it. Talent is part of the story. Both players combine relentless scoring—they are the all-time top goalscorers in La Liga, Spain's top division, and the Champions League, the leading European club competition—with brilliant passing. At their best, they function both as their side's main creator of goals and the main scorer of them.

The pair's influence also reflects globalisation, modern technology and football's growing clout. When Mr Messi played for Barcelona, he had a say in transfers and even managerial appointments. His sway was such that, when a club employee argued that Mr Messi “would not be as good” without the help of his team-mates, the staff member was quickly dismissed “for having publicly expressed a personal opinion that does not match that of the club”. Mr Messi's salary—€555m (\$577m) over his last four

years—almost bankrupted Barcelona. When Mr Ronaldo moved from Real Madrid to Juventus in 2018, his new club gained a vast number of social-media followers while his old one lost hundreds of thousands.

Traditionally, fandom means following a particular team regardless of its squad; for many in the age of Mr Messi and Mr Ronaldo, it has become about following players instead.

From 2009 to 2018, when both men played for Spanish teams, every clash doubled up as a referendum on which man was the superior star. If Mr Messi—for his grace in playing the game and sense of play—was football's Roger Federer, then Mr Ronaldo was its Rafael Nadal: less artistic, more physical, his career a triumph of sheer bloody-mindedness. Mr Messi has eschewed publicity and Mr Ronaldo has embraced it. (See the recent interview in which he criticised his current club, Manchester United.) But the authors argue that such contrasts overlook the players' "mutual understanding": "that their most important business partner is the other". If there is no friendship between the two, neither is there real animosity.

There has been a dark side to their sporting excellence. Both players allowed themselves to be courted by intolerant regimes—the United Arab Emirates in Mr Ronaldo's case and Saudi Arabia in Mr Messi's. They have largely kept politics and sport separate, in the manner of the quip uttered by Michael Jordan, a basketball player: "Republicans buy sneakers, too." Both had to repay millions to the Spanish tax authorities. Mr Ronaldo has been accused of sexual assault. (He denies the allegations and has never been charged.)

Coverage of such matters ensures that this rigorously researched book avoids becoming hagiography. The result is an ambitious and valuable study for all those who want to understand the modern world of football that Mr Messi and Mr Ronaldo have helped forge. Yet the authors might have examined the endurance of these star athletes in greater depth.

Aged 35 and 37, Mr Messi and Mr Ronaldo, albeit a little diminished, continue to play on, apparently motivated less by what they can achieve at their clubs than on the international stage, for Argentina and Portugal. Both have won one major international tournament. The weeks ahead offer the tantalising possibility that one of the pair might win the prize both covet most: the World Cup. ■



绝代双骄

梅西和C罗塑造了现代足球

一本新书探讨了他们在绿茵场内外的影响力【《梅罗之争》书评】

《梅罗之争》。约书亚·罗宾逊和乔纳森·克莱格著。Mariner Books出版社；320页；29.99美元/25英镑。

金球奖表彰全球最佳男子足球运动员，赢得该奖项被认为是球员职业生涯的至高荣誉之一。能两次获奖的球员寥寥无几；三次问鼎的有范·巴斯滕、克鲁伊夫和普拉蒂尼。有十年时间，金球奖成了梅西和C罗的双雄对决。从C罗首次获奖的2008年一直到2017年，二人包揽了每届金球奖。

此前足坛之巅从未被同样两人统霸如此之久。在《梅罗之争》（Messi vs Ronaldo）一书中，《华尔街日报》的两位记者约书亚·罗宾逊（Joshua Robinson）和乔纳森·克莱格（Jonathan Clegg）试图弄清楚他们是如何做到的。天赋是一方面。两人都有持续得分的能力，他们都是西甲（西班牙顶级联赛）和欧冠（欧洲顶级俱乐部赛事）的历史顶尖射手，同时他们还拥有过人的传球能力。在巅峰时期，他们既是球队的主要进球制造者，也是主要得分手。

两人的影响力也折射出全球化、现代科技，以及足球不断增长的影响力。当梅西为巴塞罗那效力时，他在球员转会甚至管理层任命上都有发言权。他的地位非常之高，当俱乐部有员工称如果没有队友的帮助，梅西“不会这么好”时，这名员工很快就被解雇了，“因为他公开表达了与俱乐部看法不相符的个人观点”。梅西过去四年的薪资总共是5.55亿欧元（5.77亿美元），几乎让巴萨破产。2018年，当C罗从皇家马德里转会到尤文图斯时，他的新东家在社交媒体上收获了大量粉丝，老东家却掉了数十万粉。传统上，“球迷”意味着追随某支球队，无论球员更迭，但在梅西和C罗的时代，许多球迷已经变成了追随球员。

从2009年到2018年，两人都为西班牙的球队效力，每次对抗都成了一次关

于谁是更出色的球星的公投。如果梅西堪称足球界的费德勒——因为他在这项运动中展现的优雅和纯真的快乐，那么C罗就是足球界的纳达尔——少了一些艺术，多了一些拼抢，他的职业生涯就是绝对血性的胜利。梅西一直回避众人的关注，而C罗欣然接受。（看看最近他批评曼联的采访吧。）但两位作者认为，这样的对比忽略了两球员的“相互理解”，他们懂得“他们最重要的商业伙伴正是对方”。如果说两人之间没有友谊，那么也没有真正的敌意。

他们卓越的运动表现也带有暗面。两名球员都接受了不容异议的政权向自己献殷勤——C罗是阿联酋，梅西是沙特阿拉伯。他们基本上把政治和体育分开，就像篮球运动员乔丹说的那句俏皮话：“共和党人也买运动鞋。”两人都必须向西班牙税务部门补缴数百万美元的税金。C罗曾被指控涉嫌性侵。（他否认了这些指控，也没有被起诉过。）

包含这些内容确保了这本经过严谨调研的书不会沦为一部吹捧性的传记。对于所有想要了解梅西和C罗帮助塑造的现代足球世界的人来说，这是一份雄心勃勃的宝贵研究。不过，作者本可以更深入地探究两位明星球员何以如此长青。

梅西和C罗今年分别为35岁和37岁，尽管状态略有下滑，都还在绿茵场上厮杀。激励他们的看来不只是在俱乐部取得成就，而更多是分别代表阿根廷和葡萄牙征战国际舞台。两人都赢得过一次国际大赛。接下来的几周里将上演非常吸引人的可能性，他们中的一个也许会赢得两人都最渴望的荣誉：世界杯。■



Crypto's downfall

Is this the end of crypto?

The collapse of FTX has dealt a catastrophic blow to crypto's reputation and aspirations

THE FALL from grace was hard and fast. Only a fortnight ago Sam Bankman-Fried was in the stratosphere. FTX, his cryptocurrency exchange, then the third-largest, was valued at \$32bn; his own wealth was estimated at \$16bn. To the gushing venture capitalists (VCs) of Silicon Valley he was the financial genius who could wow investors while playing video games, destined, perhaps, to become the world's first trillionaire. In Washington he was the acceptable face of crypto, communing with lawmakers and bankrolling efforts to influence its regulation.

Today there is nothing left but 1m furious creditors, dozens of shaky crypto firms and a proliferation of regulatory and criminal probes. The high-speed implosion of FTX has dealt a catastrophic blow to an industry with a history of failure and scandals. Never before has crypto looked so criminal, wasteful and useless.

The more that comes out about the demise of FTX, the more shocking the tale becomes. The exchange's own terms of service said it would not lend customers' assets to its trading arm. Yet of \$14bn of such assets, it had reportedly lent \$8bn-worth to Alameda Research, a trading firm also owned by Mr Bankman-Fried. In turn, it accepted as collateral its own digital tokens, which it had conjured out of thin air. A fatal run on the exchange exposed the gaping hole in its balance-sheet. To cap it all, after FTX declared bankruptcy in America, hundreds of millions of dollars mysteriously flowed out of its accounts.

Big personalities, incestuous loans, overnight collapses—these are the stuff of classic financial manias, from tulip fever in 17th-century Holland to the

South Sea Bubble in 18th-century Britain to America's banking crises in the early 1900s. At its peak last year, the market value of all cryptocurrencies surged to the giddy height of almost \$3trn, up from nearly \$800bn at the start of 2021. Today it is back at \$830bn.

As at the end of any mania, the question now is whether crypto can ever be useful for anything other than scams and speculation. The promise was of a technology that could make financial intermediation faster, cheaper and more efficient. Each new scandal that erupts makes it more likely that genuine innovators will be frightened off and the industry will dwindle. Yet a chance remains, diminishing though it is, that some lasting innovation will one day emerge. As crypto falls to Earth, that slim chance should be kept alive.

Amid the wreckage of the past week, it is worth remembering the technology's underlying potential. Conventional banking requires a vast infrastructure to maintain trust between strangers. This is expensive and is often captured by insiders who take a cut. Public blockchains, by contrast, are built on a network of computers, making their transactions transparent and, in theory, trustworthy. Interoperable, open-source functions can be built on top of them, including self-executing smart contracts that are guaranteed to function as written. A system of tokens, and rules governing them, can collectively offer a clever way to incentivise open-source contributors. And arrangements that would be expensive or impractical to enforce in the real world become possible—allowing artists to retain a stake in the profits from the resale of their digital works, for instance.

The disappointment is that, 14 years after the Bitcoin blockchain was invented, little of this promise has been realised. Crypto's frenzy drew in talent from bright graduates to Wall Street professionals, and capital from VC firms, sovereign-wealth and pension funds. Vast quantities of money, time, talent and energy have been used to build what amount to virtual

casinos. Efficient, decentralised versions of mainstream financial functions, such as currency exchanges and lending, exist. But many consumers, fearful of losing their money, do not trust them. Instead they are used to speculate on unstable tokens. Money-launderers, sanctions-dodgers and scammers abound.

Presented with all this, a sceptic might say that now is the time to regulate the industry out of existence. But a capitalist society should allow investors to take risks in the knowledge that they will make losses if their bets go sour. Even as crypto has imploded, the spillovers to the wider financial system have been manageable. FTX's backers included Sequoia, a Californian VC firm; Temasek, a Singaporean sovereign-wealth fund; and the Ontario Teachers' Pension Plan. All have lost money, but none catastrophically.

Moreover, sceptics should acknowledge that nobody can predict which innovations will bear fruit and which will not. People should be free to devote time and money to fusion power, airships, the metaverse and a host of other technologies that may never come good. Crypto is no different. As the virtual economy develops, useful decentralised applications may yet appear—who knows? The underlying technology continues to improve. An upgrade to Ethereum's blockchain in September radically reduced its energy consumption, paving the way for it to handle high transaction volumes efficiently.

Instead of over-regulating or stamping out crypto, regulators should be guided by two principles. One is to ensure that theft and fraud are minimised, as with any financial activity. The other is to keep the mainstream financial system insulated from further crypto-ructions. Although blockchains were explicitly designed to escape regulation, these principles justify regulating the institutions that act as gatekeepers for the cryptosphere. Requiring exchanges to back customer deposits with liquid

assets is an obvious step. A second is disclosure rules that reveal if, say, a gargantuan and dubiously collateralised loan has been made to the exchange's own trading arm. Stablecoins, which are meant to hold their value in real-world currency, should be regulated as if they were payment instruments at banks.

| *Tulip bulb or light bulb?*

Whether crypto survives, or becomes a financial curiosity like the tulip bulb, will not ultimately depend on regulation. The more scandals ensue, the more the whole enterprise and its aspirations become tainted. The lure of innovation means nothing if investors and users fear their money will disappear into thin air. For crypto to rise again, it must find a valid use that leaves the dodginess behind. ■



【首文】加密货币的坠落

加密货币末日已至？

FTX爆雷给加密货币的声誉和愿景带去灾难性一击

从神坛的跌落速度快、摔得狠。不过两周前，山姆·班克曼-弗里德（Sam Bankman-Fried）还身在云端。他的加密货币交易所FTX是当时全球第三大交易所，估值达320亿美元，个人身家估计有160亿美元。在硅谷那些赞不绝口的风险资本家眼中，他是个金融天才，可以边打电子游戏边惊艳投资者，也许注定会成为全球首位万亿富翁。在华盛顿，他曾被认为是加密货币行业里的体面人，与议员们往来密切，作为金主支持影响加密货币监管决策的行动。

如今，只剩下一百万愤怒的债权人、数十家摇摇欲坠的加密货币公司、一大堆监管和刑事调查。FTX的迅速爆雷给这个充斥失败与丑闻的行业带来了灾难性一击。加密货币从未显得如此罪恶、浪费、无用。

有关FTX破产的内幕爆出越多，整件事就越发惊人。该交易所的服务条款写明不会把客户的资产借给自己的交易部门。然而据报道，FTX已把140亿美元客户资产中的80亿借给班克曼-弗里德拥有的另一家交易公司阿拉米达（Alameda Research），所接受的抵押品是FTX自家凭空创制的数字代币。最近的致命挤兑暴露了FTX资产负债表中的大窟窿。更有甚者，FTX在美国宣布破产后，数以亿计的美元从它的账户中神秘流走。

耀眼人物、“近亲”贷款、一夜崩盘——这些都是历史上最大金融狂热案例的要素，如同17世纪荷兰的郁金香热、18世纪英国的南海泡沫，以及20世纪初美国的银行危机。在去年的高峰期，各种加密货币的市场总值从2021年初的近8000亿美元飙升至令人头晕目眩的近三万亿美元。如今又跌回到8300亿美元。

和一切狂热终结时的情形一样，现在的问题是，除了诈骗和投机，加密货币还有什么别的用处吗？它曾经是一项可能会让金融中介变得更快捷、便

宜和高效的技术。每次爆发新的丑闻都更有可能吓跑真正的创新者，令整个行业逐渐萎缩。不过，尽管机会在变小，未来出现长久持续的创新的可能性依然存在。在加密货币跌下神坛之际，要留存好这一线可能。

经过近期的一地鸡毛，还是要记得加密技术的根本性潜力。传统银行业务需要一个庞大的基础设施架构来维持陌生人之间的互信。这成本很高，而且常常发生内部人员操控自肥的情形。相比之下，公共区块链建立在一个计算机网络之上，这让它们的交易透明，从理论上讲也可信赖。在此基础上可以建构具有互操作性的开源功能，包括被确保会按代码自动执行的智能合约。一个代币系统加上相关管理规则能以巧妙的方式激励开源贡献者。而且，在现实世界中执行起来成本高昂或不切实际的操作变得可能，比如，艺术家可以从数字作品的转售利润中分成。

令人失望的是，在比特币区块链发明14年后，这一预言基本没有实现。加密货币热吸引了从顶尖毕业生到华尔街专业人士的各类人才，也吸引了风险投资公司、主权财富和养老基金的资本。花费如此大量资金、时间、人才和精力打造出的却是个虚拟赌场。虽然主流金融功能的更高效且去中心化的版本确实存在，如货币兑换和借贷等，但许多消费者并不信任它们，担心会损失金钱。相反，它们被用来炒作不稳定的代币。里头尽是洗钱的、逃避制裁的和搞诈骗的。

面对这一切，对这个行业持怀疑态度的人可能会说是时候取缔它了。但资本主义社会应该允许投资者冒险，既然他们很清楚赌输就会有损失。在加密货币爆雷之时，对更广泛金融系统的溢出效应一直可控。FTX的投资者包括加州风投公司红杉资本、新加坡主权财富基金淡马锡和安大略省教师退休金计划，这些机构都亏了钱，但都不至于一败涂地。

此外，怀疑人士应该承认，没有人能预测哪些创新会开花结果，哪些不会。应该允许人们自由地把时间和金钱投入到核聚变发电、飞船、元宇宙等许多不一定有成功那一天的技术上。加密货币也不例外。随着虚拟经济的发展，可能还会出现有用的去中心化应用，谁知道呢？加密货币的底层技术在不断改进。以太坊区块链在9月做了升级，大幅降低了能耗，为高

效处理大量交易铺平了道路。

与其过度监管甚或取缔加密货币，监管部门更应该按两大原则行事。一是确保最大程度减少盗窃和欺诈行为，正如监管任何金融活动一样。二是让主流金融系统隔绝于更多加密货币的纷乱震荡。虽然区块链明摆着是为逃避监管而设计的，上述原则为监管那些扮演币圈守门人的机构提供了理据。一个显然应该采取的措施是要求交易所用流动资产作为客户存款的保证。另一个是要规定加密货币交易所必须披露是否把没有可靠抵押的大量贷款提供给自家交易部门。意在锚定现实世界货币以保持币值的稳定币应该像银行的支付工具那样受到监管。

| 是郁金香还是灯泡？

加密货币是存活下来还是成为郁金香那样的金融奇谈，最终并不取决于监管。丑闻越多，整个行业及其抱负就越受玷污。如果投资者和用户担心自己账上的钱会不翼而飞，创新的召唤就毫无力量。加密货币要东山再起，必须找到正当合理的用途，甩掉那股狡诈气。■



Fresh factories

Who wins from the unravelling of Sino-American trade?

A series of shocks are transforming international commerce

FROM DISEASE and downturn to the deterioration in Chinese-American relations, there has been no let-up to the blows battering the world's trading system. The latest threat stems from the possibility of another global recession. Only two years after the world sank into a covid-induced slump, shipping bosses are again warning of grim prospects for international trade.

Even beyond the ups and downs of the economic cycle, deeper shifts in global trade are taking place. Firms are reconsidering their production decisions, and governments are pushing the process along. Such shifts might have seemed outlandish in 2018 when Donald Trump, then America's president, first slapped tariffs on imported Chinese goods. Since then, a pandemic has struck, and President Joe Biden has banned the export of advanced semiconductor technology to China and plans to provide subsidies worth hundreds of billions of dollars for investment in domestic manufacturing. A rejigging of trade now feels inevitable rather than unimaginable—and the outline of its new geography is becoming clearer.

Global trade in goods staged an impressive bounceback after the covid-19 downturn in 2020. As a share of world GDP, its value last year rose to the highest level since 2014. But not all trade routes are flourishing. When Mr Trump took his protectionist turn, there was hope that economies in Africa and Latin America might attract some of the business that would have otherwise flowed to China. Instead, the biggest winners from changing trade patterns are to be found in Asia.

Global trade data emerge slowly. Figures on imports to big economies are

therefore the best way to get an up-to-date picture of what is happening. According to American data released on November 3rd, the country's imports have risen by a third since 2018. Gains, though, have been unevenly distributed. American imports of Chinese goods stand just 6% above four years ago, a hefty decline in China's market share since President Trump launched his trade war. America's imports from the EU have also grown in lacklustre fashion, up by just 12% since 2018. "Friendshoring" may be happening, but not on a grand scale. Imports from Canada and Mexico have risen by 39% and 34% respectively.

The great champions of the past four years are in Asia. Exports to America from Bangladesh and Thailand have jumped by more than 80% since 2018; exports from Vietnam are up by more than 170% (see chart). India and Indonesia have seen their exports grow by more than 60%. As a result, China's share of American imports dropped by four percentage points between 2018 and 2022, from 21% to 17%. China used to account for nearly half of Asia's exports to America; now it accounts for just over a third.

Nor is this simply an American trend. China is also importing more from Asia. Over the first nine months of this year, the share of China's imports coming from America fell by two percentage points compared with the same period in 2018. The share coming from the EU declined by a similar amount. On the other hand, the Association of South-East Asian Nations (ASEAN), a regional club of ten countries, saw its share of China's imports grow by two percentage points. European trade figures are less up-to-date, but Asia's rise is also visible in them. Although the share of EU imports arriving from China increased last year, so did those from South and South-East Asia. Neither China nor Europe saw a comparable rise in imports from other regions of the world.

Cultivating new sources of goods or components takes time and investment, so the shift in trade patterns now visible in the data mostly

reflects choices firms made well before this year's geopolitical ructions. Some redistribution of trade would have happened even in placid economic conditions. Rising labour costs in China, for instance, would have made it attractive to move low-value sorts of manufacturing—in textiles and apparel, say—to places like Bangladesh.

However Mr Trump's tariffs seem to have played an important role. According to recent analysis of industry data by Chad Bown of the Peterson Institute for International Economics, a think-tank, China's share of America's imports rose from 36% to 39% this year in goods not covered by tariffs. For goods subject to a 7.5% tariff, however, China's share sank from 24% to 18%. And for those hit by a whopping 25% tariff, which covers lots of IT equipment, China's share of imports fell from 16% to 10%. Overall America is now much less dependent on Chinese goods, from furniture to semiconductors.

This change is more nuanced than it appears at first glance. It seems likely that many of the components used to make goods in India or Vietnam are themselves produced in China. Although the detailed supply-chain data needed to say for sure will not be published for several years, Chinese export figures are certainly suggestive. The two-percentage-point drop in the share of China's total exports destined for America over the period from 2018 to 2022 is exactly matched by the increase in China's exports to ASEAN economies.

The story so far seems to be one in which Asia's emerging economies increasingly intermediate trade between China and the rich world. Dreams that supply chains draped across Latin America and Africa would remake the world's economic geography are still nothing more than dreams. But this direction of travel is an unalloyed boon for a rapidly growing arc of countries stretching from India to the Philippines. In time, as the consequences of recent geopolitical developments accumulate, an ever

larger share of the value in Asian supply chains may concentrate outside of China rather than within it. ■



全新工厂

中美贸易脱钩让谁受益？

一系列冲击正在改变国际贸易格局

从疾病、经济低迷到中美关系恶化，世界贸易体系屡遭打击，未有喘息之机。最新的威胁是全球可能再次陷入衰退。在疫情引发全球经济急跌后仅仅两年，航运业的老板们再次就国际贸易的严峻前景发出警告。

即使不看经济周期的起伏，全球贸易也在发生更深层次的变化。企业正在重新考虑生产决策，政府对此推波助澜。要放在2018年时任美国总统特朗普首次对中国商品加征进口关税时，这样的转变还会叫人看不懂。但自那之后，全球疫情爆发，而美国总统拜登禁止对华出口先进半导体技术，并计划为本国制造业投资提供数千亿美元补贴。如今，贸易的调整不再不可想象，而似乎已经不可避免——新格局的轮廓也日渐清晰。

2020年新冠疫情引发衰退后，全球商品贸易上演了亮眼的反弹。去年，贸易占全球GDP的比重上升至2014年以来的最高水平。但并非所有的贸易路线都欣欣向荣。当特朗普转向贸易保护主义时，人们曾希望非洲和拉美的经济体能吸引一部分原本会流向中国的业务。然而，贸易模式改变的最大赢家却出现在亚洲。

全球贸易数据的统计需要较长时间。因此，大型经济体的进口数据最能够反映最新情况。根据美国11月3日发布的数据，自2018年以来，美国进口已经增长了三分之一。然而，增长的分布并不均衡。美国从中国的进口额仅比四年前高6%，自特朗普发起贸易战以来，中国所占市场份额已大幅下滑。美国从欧盟的进口也增长乏力，自2018年以来仅增长了12%。“友岸外包”可能正在发生，但未成气候。从加拿大和墨西哥的进口分别增长了39%和34%。

过去四年的最大赢家都在亚洲。自2018年以来，孟加拉国和泰国的对美出口增长了80%以上；越南的对美出口增幅更是超过170%（见图表）。印度

和印尼的出口均增长60%以上。因此，从2018到2022年，中国在美国进口中所占份额下降了四个百分点，从21%降至17%。以前中国在亚洲对美出口中近乎占据半壁江山，而现在仅略高于三分之一。

这种趋势不仅发生在美国。中国也在增加从亚洲的进口。今年头九个月，美国在中国进口中的占比较2018年同期下降了两个百分点。来自欧盟的进口份额也出现类似降幅。而另一方面，由十个国家组成的区域组织东盟在中国进口中的份额增长了两个百分点。欧洲的贸易数据不算太新，但仍然可以明显看出亚洲所占的份额增加。尽管去年中国在欧盟进口中的份额上升，但南亚和东南亚的占比同样也上升了。世界其他地区在中国和欧洲的进口份额均没有出现类似的增长。

培养新的商品或零部件供应源需要时间和投资，因此当前数据显示的贸易模式转变主要反映了企业早在今年地缘政治动荡之前就做出的选择。即使经济条件风平浪静，一定程度的贸易再分配仍会发生。例如，中国不断上涨的劳动力成本会促使纺织和服装等低价值制造业转移到孟加拉国等地。

不过，特朗普的关税似乎发挥了重要作用。根据智库彼得森国际经济研究所（Peterson Institute for International Economics）的查德·鲍恩（Chad Bown）最近对行业数据的分析，未被加征关税的中国商品今年在美国进口中的份额从36%上升到39%。而被加征7.5%关税的中国商品的份额从24%下降到18%。对于那些被加征25%高额关税的商品（包括许多IT设备），中国的份额从16%下降到10%。总体而言，从家具到半导体，美国现在对中国商品的依赖程度已经大大降低。

这种变化比表面看来更加复杂。印度或越南产商品所用的许多零部件很可能本身产自中国。虽然能证实这一点的详细供应链数据要在几年后才会发布，但中国的出口数据显然已透露端倪。2018至2022年期间，中国对美出口的份额下降了两个百分点，而这正好与中国对东盟经济体的出口增幅吻合。

就目前来看，亚洲新兴经济体似乎日益成为中国和发达国家之间的贸易中

间人。那些展望横跨拉美和非洲的供应链将重塑世界经济版图梦想依然只是梦想。但对于从印度到菲律宾的一批队伍迅速扩大的国家来说，这种贸易走向是绝对的福音。随着近期地缘政治动向的影响逐渐累积，亚洲供应链中越来越多的部分可能将会集中在中国境外而非其境内。 ■



Buttonwood

Are tech stocks now good value?

Perhaps they are—which will not please their owners

AS ANY SAVVY shopper knows, there is a world of difference between a sale and a deal. Just because something is discounted from its initial price does not mean that it is worth buying—perhaps the sticker price was far too high originally, the discount is too small or the item is simply poor quality. Such considerations will be on the minds of people hitting the shops on November 25th for “Black Friday”, a mammoth sale which follows America’s Thanksgiving holiday.

They are always on the minds of investors. “Whether we’re talking about socks or stocks, I like buying quality merchandise when it is marked down,” Warren Buffett, a celebrated investor, once joked. Most share prices have fallen this year—the S&P 500 index of American stocks has shed more than a fifth of its value—but the prices of technology stocks have plunged most precipitously. The tech-heavy NASDAQ is down by almost a third, after poor third-quarter earnings precipitated yet another sell-off. Amazon, Netflix and Meta have this year shed a whopping 48%, 58% and 70% of their value. Such discounts mean tech stocks are certainly on sale. But are they a good deal?

The art of evaluating whether a company is a bargain at its current price is one practised by so-called value investors, who earn that title because they seek out stocks unloved by other investors despite solid fundamentals. For much of the past decade, tech stocks have been an unattractive proposition to these parsimonious types. That is in part down to how value investors assess companies and in part down to the characteristics of tech firms.

The original value investor was Benjamin Graham, an academic and author,

in whose footsteps Mr Buffett treads. And Graham relied most of all on two measures: the ratio of share price to earnings, which compares the market value of a firm with its profits; and price to book value, which compares a share price to the value of a company's assets, such as property, equipment and inventories.

For much of the past decade tech stocks have looked mighty expensive on these measures. At the beginning of the year, the share prices of Alphabet, Amazon, Apple, Meta and Netflix were on average 38 times earnings and 12 times book value. The equivalent figures for the Russell 1000, a broad index of stocks, were 24 times earnings and four times book value. Neither group would have qualified as a deal for Graham: he liked firms priced at below 15 times earnings and 1.5 times book value. But tech's multiples would have been particularly off-putting.

These sky-high valuations partly reflected tech companies' characteristics. Firms from Alphabet to Zoom tend to have relatively few physical assets that are captured by book value and many intangible ones—such as software and human capital—that are typically not included. They also tended to be fast growers, meaning that measuring their price against present earnings risked understating future profits. For this reason, tech stocks appealed more to “growth” investors, who tend to buy companies with rapidly rising profits, than they did to value types.

This means value investors missed out on years of growth, but also dodged the recent rout. Are tech prices now low enough for them to take a look? Some stocks, including Amazon and Netflix, remain expensive on favoured measures. Other smaller ones, including PayPal and Zoom, may attract interest. So might two giants. Alphabet, with a price-to-earnings ratio of 17, looks cheaper than most value stocks. Meta, which currently trades at just nine times earnings and two times book value, might have piqued even Graham's interest. Tech investors have long been conscious of having paid a

lot for their shares, but hoped these valuations would be justified in the long-run. The fact that many tech stocks now qualify as value stocks will come as a considerable blow.

Perhaps the idea that value investing and tech stocks are inherently incompatible was simplistic. Modern value investing is practised by all sorts, including a number of quantitative investors such as Cliff Asness at AQR Capital Management, who crunch vast data sets to compare firms against wide and varied measures of their worth. Rather than comparing the results with arbitrary criteria across all kinds of firms, they instead tend to compare them within industries. But one thing remains true regardless of the sophistication of the analysis. Tech stocks today are much better value than they were at the start of the year. ■



梧桐

科技股现在物超所值吗？

也许是——它们的持有人可就不高兴了

任何老道的购物者都知道，打折和划算相去甚远。某样东西按最初价格的几折出售并不意味着它就值得买——也许它原价太高、打折力度太小，或者这个东西根本就品质不佳。美国感恩节后的大甩卖“黑色星期五”将于11月25日到来，届时前去购物的人们会盘算这些。

投资者也总是会考虑这些。“不管是袜子还是股票，我都喜欢在降价的时候买优质的商品。”著名投资者沃伦·巴菲特曾开玩笑说。今年大多数股票的价格都下跌了，美股的标普500指数的市值已下跌超过五分之一，但还是科技股跌得最猛。此前糟糕的第三季度收益报告引发了新一轮抛售，以科技股为主的纳斯达克指数应声下跌近三分之一。亚马逊、奈飞和Meta今年的市值分别缩水了48%、58%和70%。“折扣”如此之大，科技股无疑是在大促销中。但它们真的划算吗？

要评估在当前价格买下某家公司的股票是否划算，所谓的“价值投资者”很熟悉这其中的门道。他们获得这一名号是因为他们专门寻觅那些基本面很稳健却不受其他投资者青睐的股票。在过去十年的大部分时间里，这些出手节俭的人一直不觉得科技股有什么吸引力。这一方面要归结于价值投资者评估公司的方式，另一方面要归因于科技公司的特质。

最早的价值投资者是学者兼作家本杰明·格雷厄姆（Benjamin Graham），巴菲特追随了他的脚步。格雷厄姆主要依赖两个指标：市盈率，比较公司的市值和它的利润；市净率，比较股价与公司资产例如不动产、设备和库存的价值。

以这些标准衡量，过去十年的大部分时间里科技股都非常昂贵。今年年初，Alphabet、亚马逊、苹果、Meta和奈飞的平均市盈率是38倍，市净率是12倍。涵盖多种类股票的罗素1000指数对应的数字分别是24倍和4倍。

两组都不会让格雷厄姆觉得划算：他喜欢市盈率低于15倍、市净率低于1.5倍的公司。但科技股的这些倍数会格外令他敬而远之。

这些天价估值一定程度上反映了科技公司的特点。从Alphabet到Zoom的公司的账面价值往往只计入了相对较少的有形资产，而许多无形资产——如软件和人力资本——通常都不反映在其中。此外它们通常成长迅速，这意味着以现在的收入来衡量其价格可能会低估未来的利润。出于这个原因，比起价值投资者，科技股对“成长”投资者更有吸引力，后者倾向于购买利润增长迅速的公司的股票。

这意味着价值投资者错过了多年的增长，但也躲过了近期的暴跌。那现在科技股的价格已经低到值得他们看一眼的程度了吗？即使以有利的标准来衡量，包括亚马逊和奈飞在内的一些股票仍然很贵。PayPal和Zoom等其他稍小的公司可能会引起些兴趣。两家巨头公司可能也是这样。Alphabet的市盈率为17倍，看起来已经比大多数价值股都便宜。Meta目前的市盈率只有9倍，市净率为2倍——连格雷厄姆都会有兴趣吧。科技投资者早就意识到他们为股票花了大价钱，但他们希望这些估值从长远来看是合理的。而许多科技股现在都够得上价值股的标准，这对他们将是一个相当大的打击。

也许价值投资和科技股天生不相容的想法过于简单了。各种各样的人都在实践现代价值投资，包括像AQR资本管理公司的克里夫·阿斯内斯（Cliff Asness）那样的量化投资者，他们处理大量的数据集，用各种各样的价值衡量标准来比较不同的公司。他们不拿结果与各种公司一把抓的武断标准相对照，而是倾向于在行业内作比较。但是不管分析有多高深莫测，有一点毋庸置疑：眼下科技股比年初时划算多了。■



Fertility trends

American-born women had more babies during the pandemic

College-educated women saw the biggest increase, reversing years of decline

BIRTH RATES often fall during hard times, but the covid-19 pandemic was no ordinary economic downturn. On the one hand, people might hesitate to procreate amid such upheaval; on the other, the opportunity to work from home could make parenting more enticing. During the dark days of lockdowns, no one knew which of these effects would be greater.

At first glance, the data from America suggest that covid did prompt a small baby bust. Birth counts fell from 3.75m in 2019 to 3.62m in 2020, and rebounded only partway to 3.67m in 2021. However, a new study by Martha Bailey, Janet Currie and Hannes Schwandt reaches the surprising conclusion that despite this apparent decline, fertility rates among women born in America actually rose during the pandemic—the first big annual increase since 2007.

The first clue that data on total births might be misleading was the timing of the drop. Birth counts fell in early 2020, but most babies conceived after covid struck America in March 2020 would have been due in 2021. The study suggests instead that what changed in 2020 was not whether women gave birth, but where.

In 2019, 23% of newborns in America had foreign-born mothers. Breaking down the data on pandemic-era births by mothers' origin, the researchers found a striking discrepancy: foreign-born women gave birth to 91,000 fewer babies than pre-pandemic trends would suggest, whereas native-born ones had 46,000 more.

The study did not assess how much of the dip stemmed from fewer foreign-

born women entering the country and then giving birth, and how much from immigrants already in America deciding to leave. But given that America closed its borders for non-essential travel in 2020, a reduction in new arrivals—including those who visit briefly to have an American-citizen child, and then leave—seems more likely.

The researchers speculated that the shift to remote work explained much of native-born women's rise in fertility. The increase was most marked among the college-educated, who are more likely to be able to work from home, in a country without any paid maternity-leave requirement or child-care subsidy.

The baby bump may be temporary. But continued flexibility for couples to spend time with their babies might mean they make more of them in future too.

Chart sources: "The covid-19 baby bump: the unexpected increase in US fertility rates in response to the pandemic", by M.J. Bailey, J. Currie and H. Schwandt, National Bureau of Economic Research, 2022, working paper; National Centre for Health Statistics; kidscount.org ■



生育趋势

疫情期间，美国本土出生女性生育率增长

受过大学教育的女性是这轮增长的主力，扭转了多年的下降趋势

在艰难时日，出生率往往会下降，但新冠疫情不是普通的经济衰退。一方面，这样的剧变或许让人们在生孩子的问题上迟疑不决；另一方面，有机会居家办公或许又让养育子女变得更有吸引力。在封控的黑暗日子里，没有人知道哪一种效应会更大。

乍一看，来自美国的数据显示新冠疫情的确导致了一个生育小低谷。出生人数从2019年的375万下降到2020年的362万，在2021年只是略微回升到367万。然而，玛莎·贝利（Martha Bailey）、珍妮特·柯里（Janet Currie）和汉内斯·施万特（Hannes Schwandt）新近的研究得出了令人惊讶的结论：尽管从表面看疫情期间生育率下降了，但美国本土出生女性的生育率实际却上升了，而且是自2007年以来首个大幅度的年度增长。

出生总人口数据可能具误导性的第一个线索是下降发生的时间点。2020年初出生人口有所下降，但大部分在2020年3月美国新冠肺炎爆发后怀上的胎儿应该要到2021年才出生。该研究认为，2020年发生的变化不是女性是否生了孩子，而是她们在哪里生的孩子。

2019年，美国23%的新生儿的母亲不是美国本土出生女性。研究人员将新冠疫情期间的出生人数按照母亲的出生地进行分析后，发现了一个惊人的分叉：相比按疫情前生育趋势预测的人数，非美国出生的女性少生了9.1万名孩子，而美国本地出生女性多生了4.6万名孩子。

该研究没有评估这种下降在多大程度上是由于入境美国并在美生育的非本地出生女性人数减少，又在多大程度上源自有些移民已经人在美国却决定离开。但考虑到美国在2020年针对非必要旅行关闭了边境，新入境女性数量减少的可能性似乎更大——包括那些为了生一个有美国公民身份的孩子而短期入境并在生完后就离开的女性。

研究人员推测，转为远程办公是在美国本地出生女性生育率上升的主要原因。在美国这个完全没有带薪产假规定也没有育儿补贴的国家，这轮上升在受过大学教育的人群中最为明显，而这类人群更可能有条件居家办公。

新生命的增加可能是暂时性的。但如果夫妻俩能继续弹性工作以照顾和陪伴婴儿，那他们以后也许还会再生孩子。

图表资料来源：《新冠疫情期间的小生育潮：疫情后美国生育率的意外增长》，M.J.贝利、J.柯里和H·施万特著，美国全国经济研究所工作论文，2022年；国家卫生统计中心；kidscount.org ■



When the circus leaves town

Fosun's big asset sale marks the end of an era in Chinese business

The sprawling group is offloading many of its prize investments

IN THE PAST few years Guo Guangchang, chairman of Fosun, a Chinese conglomerate, has watched as the Communist Party has taken down his rivals. Two executives at HNA, an indebted airline that once held a big stake in Deutsche Bank, have been arrested. The founder of Anbang, an acquisitive insurer, has received a lengthy prison sentence for financial crimes. So has the founder of Tomorrow Group, a banking-and-insurance empire.

Mr Guo does not appear in imminent danger of sharing their fate. But his company is in trouble. On October 25th Moody's, a ratings agency, downgraded Fosun's debt deeper into junk territory. Chinese banks have been asking the firm to provide more collateral for loans. To meet its obligations Fosun has already divested \$5bn-worth of assets this year, according to data from Refinitiv, a research firm. By 2023 it could shed \$11bn-worth. That is quite the reversal for the asset-hungry group. It also marks the end of a freewheeling era in Chinese business, which is turning inwards under President Xi Jinping.

Fosun has sought to offer Chinese people a three-pronged lifestyle experience that targeted their "happiness, wealth and health". Customers could look to it to manage their money, plan their holidays and sell them medicines. To that end, it amassed, among other assets, a listed drugmaking division; financial-services firms in Europe; a large portfolio of fashion brands (such as St John Knits, an American women's label, and Sergio Rossi, an Italian cobbler); a 20% stake in Cirque Du Soleil, a Canadian circus; and controlling stakes in Club Med, a French resort chain, and Wolverhampton Wanderers, an English football club. The perceived

success of this strategy has led admirers in Chinese business circles to liken Mr Guo to Warren Buffett, America's revered asset-accumulator.

The reality of this success is debatable. In 2015 Mr Guo vanished for a few weeks amid a police probe, only to emerge pledging to buy fewer assets and focus on managing the ones he already has. Over the next two years Fosun divested assets worth around \$9bn. The discipline did not last; in 2017 it splurged nearly \$7bn on new investments. Soon afterwards some of its bets began to sour. In 2019 Thomas Cook, a British travel company part-owned by Fosun, filed for bankruptcy. The following year its 20% stake in Cirque Du Soleil was wiped out under similar circumstances.

Throughout, debt has loomed large. In annual investor meetings Fosun executives have routinely pledged to bring leverage down. To little effect, it seems. And things may have got dicier of late, as the company has tapped more short-term debt, which now makes up 53% of its total borrowings of \$16bn, up from 46% in 2021. Rolling it over has become harder in the past year, as many Chinese property developers have defaulted on offshore bonds, which has cooled investors' enthusiasm for Chinese firms' debt more broadly.

An even bigger problem than its debt may be Fosun's business model. It was based on a vision of the future where both China's businesses and its people travelled and spent freely around the globe. But China's zero-covid policy has trapped most Chinese at home for nearly three years and dented consumer confidence. And under the increasingly authoritarian Mr Xi, Chinese companies are viewed with growing caginess in the West. In this new world, Fosun looks like a relic of a happier time. ■



马戏散场

复星大规模出售资产标志着中国企业界一个时代的结束

这家触角广泛的集团正在剥离许多王牌投资项目

过去几年里，中国企业集团复星的董事长郭广昌眼看着共产党扳倒了他一个又一个的竞争对手。海航的两名高管被逮捕，这家曾持有德意志银行大量股份的航空公司负债累累。激进扩张的保险公司安邦的创始人因金融犯罪被判处长期监禁。银行及保险帝国明天控股的创始人也是如此。

郭广昌眼下似乎还没有落得同样命运的危险。但他的公司有麻烦。10月25日，评级机构穆迪将复星的债券下调至垃圾级。中国的银行一直要求复星为贷款提供更多抵押。研究公司路孚特（Refinitiv）的数据显示，为偿还债务，复星今年已剥离了价值50亿美元的资产。到2023年它可能会出售110亿美元的资产。对于这个惯于收购资产的集团来说，这是一种逆转。这也标志着中国企业界一个随心所欲的时代结束了，在国家主席习近平的领导下，它开始转向国内。

复星致力于为中国人提供“快乐、富足、健康”三位一体的生活方式体验。客户可以依靠它来理财、规划假期、购买药品。为此它搜罗了各色资产，其中有一个上市的制药部门、几家欧洲的金融服务公司、众多时尚品牌（如美国女装品牌St John Knits和意大利鞋履公司Sergio Rossi）、加拿大太阳马戏团（Cirque Du Soleil）20%的股份，还控股了法国度假连锁集团地中海俱乐部（Club Med）和英国足球俱乐部伍尔弗汉普顿流浪者（Wolverhampton Wanderers）。这被视为一种成功的战略，郭广昌在中国商界的仰慕者将他与美国备受尊崇的资产积累大户巴菲特相提并论。

这种成功的真实状况值得商榷。2015年，郭广昌接受警方调查，消失了数周，重新露面后他承诺减少购买资产，专注于管理已经拥有的资产。在接下来的两年里，复星剥离了价值约90亿美元的资产。这样的自律并没有持续下去，2017年，复星在新投资上豪掷近70亿美元。这之后不久它买下的部分资产开始恶化。2019年，复星部分持股的英国旅游公司Thomas Cook

申请破产。次年，它在太阳马戏团20%的股份也在类似情况下灰飞烟灭。

债务问题自始至终都很突出。在年度投资者会议上，复星的高管经常承诺降低杠杆率。但似乎效果甚微。最近情况可能变得更加危急，因为复星借了更多的短期债务，目前占其160亿美元总债务的53%，高于2021年时的46%。过去一年里展期偿还变得越发困难，因为许多中国的房地产开发商对离岸债券违约，使得投资者在更大范围内对中国企业债券的热情降温。

比债务更大的问题可能是复星的商业模式。它是基于这样一种愿景：中国的企业和民众在全球自由行动、畅快撒钱。但中国的疫情清零政策已经让大多数中国人困在本地近三年，挫伤了消费者信心。而在习日渐威权的统治下，西方对中国企业的态度越来越谨慎。在这个新世界里，复星看起来像是一段更快乐的时光的遗迹。 ■



Unconscious decoupling

Economic growth no longer means higher carbon emissions

As politicians gather in Egypt, a reason for optimism

IF ANYWHERE CAN claim to be the birthplace of the Industrial Revolution it is Coalbrookdale, a pretty village in England's West Midlands. In 1709 Abraham Darby, a local merchant, leased a foundry and fed the furnace with coking coal, rather than charcoal made from wood. The use of the fossil fuel meant he could make pig iron much more cheaply, and cast it into pots, pans and cauldrons for cooking—the kind of low-cost manufactured goods that would, over the next three centuries, produce an unprecedented rise in living standards across the world.

Darby's furnace was not just ground zero for the Industrial Revolution. It was also ground zero for global warming. Since the fateful smelting, economic output and greenhouse-gas emissions have risen in tandem. England's furnaces were joined by coal-powered railways and steam-powered textile mills, all using tools cast from coke-fuelled foundries. Between the middle of the 19th century and the outbreak of the first world war, Britain's national income per person more than doubled and its carbon emissions increased four-fold. When other countries industrialised, their emissions spiralled, too.

As politicians gather in Sharm el-Sheikh, an Egyptian holiday resort, to review progress on climate change at COP27, there is at least one cause for optimism: the historic link between rising prosperity and carbon emissions has been broken. Today Britain is a member of a large and growing group of rich and middle-income countries that has severed it. This decoupling has been achieved not through the large-scale deployment of renewable energy—or, indeed, by exporting emissions to poorer countries—but by a change in the relationship between economic growth

and energy that is perhaps as significant as those first stirrings of the Industrial Revolution three centuries ago.

All told, some 33 countries have in recent years cut emissions while maintaining growth. Around three-fifths are European, meaning, as was the case during the Industrial Revolution, the old continent is leading the way. But the group also includes America, where emissions fell by 15% between 2007 and 2019 even as GDP per person rose by 23%, as well as others that have joined more recently. These include Australia, where emissions have fallen by 9% since peaking in 2012, and Israel, where they have fallen by 12% in the same period, even as both economies have grown.

It would be wrong, however, to characterise decoupling as a luxury reserved for the most affluent countries. Thanks to energy-efficiency improvements, emissions in eastern Europe have fallen since the collapse of the Soviet Union, at the same time as living standards have converged with western Europe. Argentina, Mexico and Uruguay have also joined the decouplers. In Mexico, for instance, emissions have fallen by 16% since their peak in 2012. Around the world, before the covid-19 pandemic distorted the numbers, more than 1bn people lived in countries with falling emissions and growing economies.

Territorial emissions, which reflect domestic production, began to fall much earlier. In Britain they peaked in the 1970s, before oil shocks and strikes decimated the country's industry. But their decline merely reflected the fact that more manufacturing was taking place abroad: British clothes were being sewn in Dhaka instead of Derby, which led to no reduction in global emissions. The figures in this article mostly come from analysis of data produced by the Global Carbon Project, a greenhouse-gas-monitoring outfit. These include estimates of the emissions from imports, and so capture the vast majority of a country's carbon footprint. In other words, Britain's figures include emissions from imported T-shirts made in

Bangladesh.

The more recent decline in emissions is therefore the real deal. Part of the explanation is that the countries to which manufacturing has been outsourced now emit less carbon themselves, notes Viktoras Kulionis of Pictet Asset Management. In all but a couple of dozen industrialising countries GDP growth produces fewer carbon emissions than used to be the case, a phenomenon which is known as “relative decoupling”. In 2008 China’s exported emissions peaked at around 1.5bn tonnes of carbon-dioxide equivalent, before falling to 1bn in 2019, owing to improved efficiency and a move from chemicals and metals exports to less carbon-intensive electronics ones. Emissions imported by the OECD group of mostly rich countries peaked in 2006, at 2bn tonnes of carbon-dioxide equivalent. They have since fallen by more than a third to 1.3bn.

But the shift mostly reflects a watershed change in how energy is used in the West. Decoupling can occur for two reasons: either because output becomes less energy-intensive, or because the energy used becomes greener. For the past decade or so, it has mostly happened because of the former. The energy intensity of GDP—the supply needed to produce a dollar of national income—has fallen faster than GDP has grown. This can be seen in America. The country is often considered a polluter par excellence. In fact, its territorial emissions peaked in 2005. Since then, the energy intensity of its GDP has fallen by nearly a quarter. So even though America’s GDP has risen by 29%, emissions have fallen by 15%. Similarly, four-fifths of the fall in German emissions since 1990 reflects lower energy intensity. Only the remaining fifth comes from the use of greener energy.

Falling energy intensity is the result of changes to the structure of rich-world economies. A visitor to Coalbrookdale in the 18th century compared its smoke, heat and fire to a vision of hell. Nowadays the old furnace lies cold; the last foundry, which made parts for Aga ovens, closed in 2017; and

the site has become a tourist attraction. It is a symbol of Britain's shift from an industrial economy to a service-based economy—a shift which has big implications for emissions. As Nick Eyre, a climate-policy expert at the University of Oxford, notes, an extra trip to the theatre requires much less energy than making additional pots and pans.

The move from manufacturing to services has happened across the rich world. Industry's share of American GDP fell from 17% in 2007 to 14% by 2019. In Germany, a country known for its manufacturing prowess, its share fell by two percentage points in the same period. Even in Mexico, one of the poorer countries to have decoupled, its share dropped from 27% to 25%.

The task now is to accelerate decoupling. One reason for optimism is that so far it has happened without colossal outlays or much political consensus. Many of the West's high achievers have emissions-trading schemes, or other forms of carbon pricing, but even laggards have managed to reduce their carbon footprints. Increasing use of renewables in electricity generation, as well as electrifying the heating of homes and transport—whether through electric cars or encouraging public transport—has the potential to make a big difference.

But perhaps the greatest reason for optimism is the evidence that poorer countries are industrialising in different ways from their predecessors. Data from the Global Carbon Project suggest that Egypt, the COP27 host, reached peak emissions in 2017. India and Vietnam, which are becoming a bigger source of exports as trade shifts away from China, are considerably greener than their economic rival. In 2007, when China's economy was roughly as big as India's is today, it emitted around twice as much carbon dioxide. India and Vietnam are still powered by coal. The difference is they are making much more efficient use of it. ■



无意中的脱钩

经济增长不再意味碳排放增加

各国政要聚首埃及之际，有理由乐观展望未来

要说哪个地方堪称工业革命的发源地，当属煤溪谷（Coalbrookdale）这个位于英格兰西米德兰兹郡（West Midlands）的漂亮村庄。1709年，当地商人亚伯拉罕·达尔比（Abraham Darby）租下了一家铸造厂，用焦煤而非木炭作燃料。使用这种化石燃料让他能以大大降低的成本制造生铁，然后浇铸成用于烹饪的锅碗瓢盆，这些低成本制品在接下来的三个世纪里空前地提升了全球生活水平。

达尔比的熔炉不仅是工业革命的起点，也是全球变暖的起点。自从那改变人类命运的熔炉点燃，经济产出和温室气体排放便同步上升。除了英格兰的熔炉，还有以煤为动力的铁路和以蒸汽为动力的纺织厂，它们都使用以焦炭为燃料的铸造厂制成的工具。从19世纪中期到一战爆发，英国人均国民收入翻了一番不止，碳排放量则上升至原来的四倍。其他国家步入工业化后，排放也急剧上升。

在各国政要云集埃及度假胜地沙姆沙伊赫（Sharm el-Sheikh）参加COP27气候峰会、讨论应对气候变化的进展之际，至少出现了一个值得乐观的理由：经济增长与碳排放之间一直以来的关联已被打破。如今，包括英国在内的很多富裕及中等收入国家已经打破了这一关联，而且这个队伍还在不断壮大。脱钩靠的不是大规模部署可再生能源，也不是向贫困国家输出排放，而是通过改变经济增长和能源之间的关系，其意义也许堪比三个世纪前的工业革命萌芽。

近年来总共约有33个国家在保持增长的同时实现了减排。其中约五分之三是欧洲国家。这意味着欧洲大陆就像在工业革命时期一样，正在引领潮流。不过这个群体还包括美国（在2007年至2019年期间它在人均GDP增长23%的同时排放量下降了15%）和其他稍晚一些进入这一行列的国家，如澳大利亚和以色列。澳大利亚的排放在2012年见顶后下降了9%，以色列

在同一时期减排12%，两者在这一过程中都保持了经济增长。

然而，如果认为这种脱钩是专属于最富裕国家的奢侈品，那就错了。得益于能源效率的提升，自苏联解体以来，东欧也实现了减排，而且生活水平也在向西欧靠拢。阿根廷、墨西哥和乌拉圭也加入了脱钩的行列。例如，在墨西哥，排放自2012年达到峰值后已下降16%。全球范围内，在新冠疫情扭曲了相关数字之前，有超过十亿人生活在经济增长但排放下降的国家。

反映一国国内生产活动的“境内排放”的下降还要早得多。在英国，该数字在上世纪70年代达到顶峰，之后的石油危机和罢工大大削弱了英国的工业。但境内排放下降只不过反映出更多制造业转移到了国外。英国的成衣是在孟加拉国的达卡而非英国的德比缝制的，也就是说全球排放并未减少。本文列出的数字主要来自对温室气体监测机构全球碳计划（Global Carbon Project）所获数据的分析，其中包括对进口产品排放量的估算，所以涵盖了一个国家的绝大部分碳足迹。也就是说，英国的数字中包括了孟加拉国制造的进口T恤衫产生的排放。

因此，更近些年来排放下降才是实打实的减排。部分原因是接收制造业外包的国家自身的碳排放现在也下降了，瑞士百达资产管理（Pictet Asset Management）的维克托拉斯·库里安利斯（Viktoras Kulionis）指出。除了几十个仍在工业化过程中的国家之外，其他国家的GDP增长所产生的碳排放都比过去少，这种现象被称为“相对脱钩”。2008年，中国的出口排放达到顶峰，约为15亿吨二氧化碳当量，到2019年下降至十亿吨，原因是能效提升，加上出口产品从化学品和金属转向碳密集度较低电子产品。成员主要为富裕国家的经合组织整体进口排放在2006年达到顶峰，为20亿吨二氧化碳当量。之后下降超过三分之一，如今为13亿吨。

但这一转变主要反映的是西方国家在能源利用方式上分水岭式的变化。脱钩可以源于两方面：产出的能源密集度降低，或是使用了更环保的能源。在过去十年左右的时间里，前者是主要原因。这期间GDP能源强度（生产一美元国民收入所需的能耗）的下降速度要快于GDP的增速。美国就是这

样。人们往往视美国为典型的污染大国。事实上，它的境内排放早在2005年就已达到峰值，自那以后，其GDP能源强度已下降近四分之一。因此，尽管美国的GDP增长了29%，排放却下降了15%。同样，德国自1990年以来的减排有五分之四是由于能源强度下降，只有那其余的五分之一要归功于使用了更环保的能源。

能源强度下降是富裕世界经济结构改变的结果。在18世纪，一位来到煤溪谷的游客曾把当地烟尘滚滚、炉红火热的景象比作地狱。如今，原来的熔炉早已冷却，这里的最后一家铸造厂曾为Aga烤箱制造零件，已于2017年关闭，厂房旧址成了旅游景点。它成为英国从工业经济转向服务业经济的象征，这一转型对减排意义重大。正如牛津大学气候政策专家尼克·艾尔（Nick Eyre）指出的，多出一家门到剧院看戏所消耗的能源比多制造些锅碗瓢盆要少得多。

整个富裕世界的经济重心已从制造业转移到服务业。在美国，工业的GDP占比从2007年的17%下降至2019年的14%。在德国这个以强大制造业著称的国家，该占比在同一时期下降了两个百分点。甚至在出现脱钩的较贫穷国家之一的墨西哥，工业的GDP占比也从27%下降到25%。

当前的任务是加速脱钩。值得乐观的理由之一是，在没有巨大投入或取得普遍政治共识的情况下，加速的苗头已经出现。西方许多减排领先的国家都建立了排放权交易机制或其他碳定价机制，但即使是减排落后国也设法减少了碳足迹。加大利用可再生能源来发电，加速家庭供暖和交通用能的电气化（无论是通过推广电动汽车还是鼓励使用公共交通），都有可能带来大变化。

而保持乐观的最大理由也许是，有证据表明较贫穷国家正在实现工业化的方式与之前的国家有所不同。全球碳计划的数据表明，COP27的东道国埃及已在2017年达到排放峰值。随着贸易从中国转移，日益成为出口大国的印度和越南比它们的经济对手要环保得多。中国2007年的经济规模与现在的印度大致相当，而当年前者的二氧化碳排放约为后者如今的两倍。印度和越南仍以煤炭为主要能源，区别在于它们现在对煤炭的利用效率要高得

多。■



Bad tech

What went wrong with Snap, Netflix and Uber?

Despite superficial differences, digital darlings' business models rest on the same shaky pillars

WHEN EVAN SPIEGEL, boss of Snap, wrote in a leaked memo that the social-media firm had been “punched in the face hard by 2022’s new economic reality”, he might as well have been describing America’s digital darlings as a whole. After a multi-year bull run, the sector is suffering a sharp correction. The NASDAQ index, home to many consumer-internet companies, has fallen by over 30% in the past 12 months; the Dow Jones Industrial Average, made up of less techie firms, is down by around 10%. Crunchbase, a data provider, estimates that American tech has already shed more than 45,000 jobs this year.

Macroeconomics is partly to blame. Soaring inflation and rising mortgage repayments are leading consumers to cut back on discretionary spending—and most digital offerings are discretionary. Even the industry’s trillion-dollar giants have not been spared, despite continuing to rake in handsome profits. Alphabet, Amazon, Apple and Microsoft have collectively lost \$2trn in market value in the past year.

If you think big tech has it bad, spare a thought for the not-so-big tech. In particular, three business models embraced by firms born after the dotcom crash of 2001—and subsequently by investors—are losing steam: the movers (which shuttle people or things around cities), the streamers (which offer music and TV online) and the creepers (which make money by watching their users and selling eerily well-targeted ads). Over the past year the firms that epitomise these business models—Uber and DoorDash; Netflix and Spotify; and Snap and Meta (which has tumbled spectacularly out of the trillion-dollar club)—have shed two-thirds of their market

capitalisation on average (see chart).

Things could get worse. On November 1st Uber reported strong growth but, despite being the global leader in ride-hailing, another quarter of net losses. In its 13-year life it has so far torched \$25bn of cash, equivalent to roughly half its current market value. DoorDash, the leader in food delivery, remains lossmaking. So do Spotify (despite rising revenue) and Snap (on top of sharply slowing sales). Netflix—a child of the 1990s but a streamer only since 2007—turns a profit but its revenue grew by just 6% year on year in the third quarter, compared with a historical average of more than 20%. Meta's revenues have now shrunk for two consecutive quarters.

On the surface, the movers, streamers and creepers—and their problems—look distinct. On closer inspection, however, their businesses all turn out to face the same main pitfalls: a misplaced faith in network effects, low barriers to entry and a dependence on someone else's platform.

Start with network effects, or “flywheels” in Silicon Valley speak—the idea that a product's value to a user rises with the number of users. Once the user base passes a certain threshold, the argument goes, the flywheel powers a self-perpetuating cycle of growth. This explains why so many startups seek growth at all cost, spending millions acquiring ever more customers to get the flywheel spinning.

Network effects are real. But they also have their limits. Uber believed that its headstart in ride-hailing gave it a ticket to riches, as more riders and drivers would mean less idle time for both, drawing ever more users into an unstoppable vortex. Instead, it encountered high unit costs and diminishing returns to scale: reducing average wait times from two minutes to one would require twice as many drivers, even though most riders would barely notice the difference. DoorDash's hungry consumers likewise only require so many alternative Indian restaurants to choose

from. And what network effects the movers enjoy are local; a user in New York cares little about the popularity of the app in Los Angeles.

Spotify and Netflix also try to capitalise on network effects, as data on the listening and viewing habits of similar users promised to deliver an unbeatable product. Belief that Netflix's trove of user information would give it a winning edge in creating content has been shattered by flops like "True Memoirs of an International Assassin", which scored a rare 0% audience rating on Rotten Tomatoes, a review website. For the creepers—whose social networks are a network-effects business par excellence—the worry is what happens if the flywheels start spinning in reverse. Meta had a scare in the fourth quarter of 2021, when it lost 1m users. That loss did not turn into a stampede; the company has added users since. Next time it may not be so lucky.

The second problem—low barriers to entry—is another supposed boon turned bane. Advances in technology, from smartphones to cloud computing, allowed all manner of startups, including the movers, streamers and creepers, to build consumer software cheaply and quickly. But that also meant that copycats soon emerged, and easy money allowed them to offer generous discounts to quickly build the minimum necessary scale.

Although at home Uber faces only one real ride-hailing rival, Lyft, its global expansion soon ran up against local rivals such as Didi in China or Grab and Gojek in South-East Asia. Meanwhile, the combination of relatively simple products and free-of-charge user experience means a new twist on social media can be enough for a new challenger to gain momentum: just try prying a teenager from TikTok.

The barriers to entry for the streamers are higher—Netflix and Spotify spend a lot of money making or licensing content. But they are not

insurmountable for deep-pocketed rivals. To fend off the challenge from Disney, which is spending a total of \$30bn a year on content, Netflix must keep splurging, too, to the tune of around \$17bn a year. Like customer-acquisition costs for the movers, content costs eat into streamers' profits. Disney's streaming services lost \$1.1bn in the second quarter of this year and the company has said that its Disney+ platform expects to lose money until 2024. Heavy investment explains why Netflix's free cashflow (the money companies generate after subtracting capital investments) is equal to only 6% of revenue.

The third flaw common to the three wobbly business models is their reliance on distribution platforms that are not their own. Uber and DoorDash pay a handsome fee to advertise on Apple's iPhone and Alphabet's Android app stores. Spotify forks over a 15% commission on subscriptions purchased on iPhones—a tax so annoying that it has filed a complaint against Apple over it. Netflix avoids the commission by forcing users to subscribe through their web browser, shifting the irritation to the customer—and quite possibly missing out on subscriptions.

Worst affected by the lack of their own rails are the creepers. Their dependence on the iPhone-Android duopoly is an existential threat. Apple's newish requirement that users give iPhone apps permission to track their activity across other apps and websites, a move replicated by Alphabet, may this year cost Meta \$10bn in forgone revenue. Parler, a creeper favoured by the far right, was temporarily suspended by both Apple and Android. If American national-security hawks worried about TikTok's Chinese ownership get their way and force Apple and Alphabet to expel it from their app stores, the rising star of social media could find itself similarly thwacked.

The different business models do not face an equal balance of challenges. The movers would be in better nick if the industry had meaningful barriers

to entry. The streamers might have been able to bat away new entrants if network effects had been stronger. And the creepers were in reasonable shape until Apple and Alphabet spoiled their party. One shaky pillar is problematic enough. Three of them is a disaster waiting to happen. ■



科技坏头

Snap、奈飞和优步出了什么问题？

数字宠儿们的商业模式表面上各不相同，但都建基于同样几根不牢靠的支柱上

在一份泄露的备忘录中，Snap的老板埃文·斯皮格尔（Evan Spiegel）写道，自己的社交媒体公司“被2022年新的经济现实狠狠打了一记耳光”。他这话可能也是美国所有数字宠儿现状的写照。在经历多年的牛市之后，这个部门正在承受一轮急剧修正。涵盖许多消费互联网公司的纳斯达克指数在过去12个月里下跌逾30%；而由科技含量不那么高的公司组成的道琼斯工业平均指数下跌了约10%。数据供应商Crunchbase估计，美国科技行业今年迄今已经裁员超过4.5万人。

这在一定程度上要归咎于宏观经济。通胀不断飙升和按揭还款不断增长迫使消费者削减可有可无的开支——而大多数数字产品都属于这类开支。即使是市值万亿美元的行业巨头也未能免受影响，虽然它们还在继续攫取可观的利润。Alphabet、亚马逊、苹果和微软的市值在过去一年总共损失了两万亿美元。

如果你认为科技巨头的境况不妙，那也请关心一下那些第二梯队公司吧。在2001年互联网泡沫破灭后诞生的一批公司所热衷的三种商业模式（后来也受到投资者追捧）尤其正在失去动力。它们分别是：“搬运工”（在城市里运送人员或物品）、“播放器”（提供在线音乐和电视）和“潜行者”（通过密切观察用户并销售精准得有点吓人的定向广告来赚钱）。过去一年里，这三种商业模式的典型代表——优步和DoorDash、奈飞和Spotify、Snap和Meta（已经暴跌出万亿美元俱乐部），它们的市值平均缩水了三分之二（见图表）。

情况可能还会恶化。11月1日优步公布的财报显示其营收增长强劲，但这个全球网约车行业领军者还是再次录得季度净亏损。自13年前成立以来，优步已经烧掉了250亿美元，大约相当于它当前市值的一半。外卖行业的领跑者DoorDash仍在亏损。Spotify（尽管营收在增长）和Snap（销售也在

大幅放缓)也是如此。奈飞诞生于上世纪90年代,但它从2007年起才成为流媒体公司。虽然它在今年第三季度实现盈利,但收入同比增长仅6%,而它的历史平均增速超过20%。Meta的收入迄今已经连续两个季度缩水。

从表面上看,搬运工、播放器和潜行者完全不是一码事,它们的问题也各不相同。但仔细观察就会发现,它们的业务都面临同样的重大隐患——盲目相信网络效应、准入门槛低、依赖第三方平台。

先说网络效应,在硅谷也叫“飞轮”效应,即产品对用户的价值会随着用户数量的增长而增长。这种观点认为,一旦用户基数达到某个阈值,飞轮就会驱动一个自我持续的增长循环。这就是为什么那么多创业公司不惜一切代价寻求增长,砸千百万美元赢得更多客户,以求让飞轮转起来。

网络效应确实存在,但它也有自己的局限性。优步认为它在打车领域的先发优势会为自己打开财富的大门,因为乘客和司机越多意味着双方等待的时间都会越少,也就能吸引越来越多的用户进入这永无止息的涡流中。而事实上,优步遇到了单位成本高企和规模收益递减的问题:把平均等待时间从两分钟减到一分钟,司机人数就需要翻一番,而大多数乘客几乎注意不到这一分钟的差异。同样,对DoorDash来说,饥肠辘辘的消费者也不需要太多的印度餐厅供他们选择。而且,搬运工们享受的网络效应只局限于本地:纽约的用户并不在意这样一个应用在洛杉矶有多受欢迎。

Spotify和奈飞也试图利用网络效应,因为有关同类用户的收听和观看习惯的数据有望催生无敌的产品。人们曾认为,奈飞丰富的用户信息会让它在内容创作方面拥有制胜优势,但《国际杀手的真实回忆录》(True Memoirs of an International Assassin)等失败影片粉碎了这种观点,该片在影评网站烂番茄(Rotten Tomatoes)上罕见地得到了0%的新鲜度。潜行者的社交网络是最典型的网络效应公司,它们担心的是如果飞轮开始反向旋转会发生什么。Meta在2021年第四季度就受到了惊吓,当时它失去了100万用户。所幸那次用户流失没有演变成大逃亡,此后用户人数有所回升。下一次它可能就没那么幸运了。

第二个问题是准入门槛低，这又是一个看起来是好事却变坏事的情形。从智能手机到云计算，科技进步让包括搬运工、播放器和潜在者在内的各种创业公司能快速、低成本地创建消费软件。但这也意味着很快就会出现模仿者，而且因为钱来得容易，这些模仿者也能够提供慷慨的折扣以迅速达到必要的最低规模。

尽管优步在美国市场上只有Lyft这一个真正的竞争对手，但它在全球扩张时很快就遇到了本土对手，如中国的滴滴，东南亚的Grab和Gojek。与此同时，相对简单的产品和用户免费体验的结合意味着社交媒体上的一个新花样就足以让一个新的挑战者得势：试试把一个青少年从TikTok拽开就知道了。

播放器的进入门槛相对高些——奈飞和Spotify在内容的制作和授权上投入了大量资金。但对于财力雄厚的竞争对手来说，这并非不可逾越。迪士尼每年在内容上的总花费达300亿美元。为了应对来自迪士尼的挑战，奈飞也必须维持每年约170亿美元的大笔支出。就像搬运工的获客成本一样，内容成本也侵蚀了播放器的利润。迪士尼的流媒体服务今年第二季度亏损11亿美元，迪士尼说过自己的Disney+平台预计到2024年都将处于亏损状态。奈飞的自由现金流（公司经营产生的现金流量减去资本投资）只相当于收入的6%，就是因为它的投资之巨。

三种不牢靠的商业模式共有的第三个缺陷是依赖非自有的分销平台。优步和DoorDash花费大笔费用，在苹果的iPhone和Alphabet的安卓手机的应用商店上打广告。Spotify要给在iPhone上购买的订阅支付15%的佣金——这笔“税”让Spotify十分恼火，已经为此投诉苹果。奈飞为了避免支付佣金，强迫用户通过他们的网络浏览器来订阅，这把烦恼转嫁给了客户，也很可能会让它失去一些订阅量。

缺乏自有分销平台对潜在者的影响最为严重。它们对“iPhone-安卓”双寡头的依赖威胁到了自己的生存。苹果早前出台新规定，由用户决定是否允许iPhone的应用跟踪他们在其他应用和网站上的活动，Alphabet也效仿了这一做法，这可能会让Meta在今年损失100亿美元的收入。美国极右派喜爱

的定向广告应用Parler一度被苹果和安卓系统下架。如果对TikTok的中国东家有顾虑的美国国家安全鹰派人士占了上风，迫使苹果和Alphabet将其从它们的应用商店中下架，TikTok这个社交媒体的后起之秀可能会遭遇到同样的重击。

这些挑战对不同商业模式的冲击力不尽相同。如果有够高的行业准入门槛，那么搬运工们的处境相对会好一些。如果当年网络效应更强些的话，播放器们或许能够击退新进入者。在被苹果和Alphabet扫了兴之前，潜行者的日子还算好过。一根柱子摇晃就够麻烦了。三根一起晃，是要出大事的。■



She make money moves

Two new biographies explore the rise and reign of Janet Yellen

America's treasury secretary is known for her meticulousness and "moral passion"

Yellen. By Jon Hilsenrath. Harper Business; 400 pages; \$32.50 and £25

Empathy Economics. Owen Ullmann. PublicAffairs; 480 pages; \$32 and £25

JANET YELLEN has a strong claim to being the world's most powerful woman of the past quarter-century. In the late 1990s she led the Council of Economic Advisers in Bill Clinton's administration. In the 2000s she held a series of positions within the Federal Reserve before ascending to its apex as chair in 2014. Over the past two years she has led the Treasury. She is the only person to have served in all three of these roles, and has spent decades wielding influence over the American and, by extension, global economy.

Perhaps the most striking feature of all her power is how little it has changed her, a wonkish economist with a moral compass. Ms Yellen is esteemed by peers and subordinates alike as a fundamentally decent person, committed to the value of public service. She has remained scrupulously faithful to evidence, not ideology—sometimes to the detriment of her career, at least temporarily. And she seems determined not to play political games in Washington, that most political of cities.

Two new biographies ask the questions of how the unassuming Ms Yellen managed to rise so far and what she has accomplished. "Yellen", by Jon Hilsenrath of the Wall Street Journal, traces not just her arc but also that of her husband, George Akerlof, a fellow economist and a Nobel laureate. It is an elegant and erudite depiction of their intellectual voyages in pursuit of the idea that markets can fail and that sensible government action can improve people's lives. That might seem banal but, when they started out, it

was a controversial pushback against the laissez-faire creed that had swept through economic theory in the 1970s. “Empathy Economics” by Owen Ullmann, a veteran journalist, is a more straightforward, pacy account of Ms Yellen’s trajectory, full of reflections from colleagues and friends.

What, then, are the ingredients of Ms Yellen’s formidable career? One thing that stands out, known to all around her, is her consummate planning for tasks big and small. She arrives at the airport hours ahead of flights and is often the first person in the departure lounge. Before providing her official signature for paper currency as treasury secretary, she reviewed the scribbles of those who had preceded her and practised hers again and again. As Fed chair, she would take three days to get ready for quarterly news conferences, asking staff to throw every conceivable question at her. A little fastidious, perhaps. Yet in the male-dominated world of economics, Ms Yellen has thrived by being the best prepared and usually the most knowledgeable person at the table.

Ms Yellen is driven by what she herself has called “moral passion”. It is the view that economics—properly analysed and applied—makes the world a better place. Her primary focus, both as an academic and as a policymaker, has been on how to reduce unemployment. “These are fucking people!” she exclaimed once at the Fed during an abstract discussion about joblessness. She is also known for her integrity, exemplified by a speech she gave as Fed chair in 2017 defending tough regulation of banks, risking the ire of Donald Trump’s advisers who were seeking to water down rules. That, plus Mr Trump’s apparent view that the diminutive Ms Yellen did not look the part of a central banker, sealed her fate: he declined to renew her for a second term at the Fed’s helm.

But that same integrity, combined with her powerful intellect, is what allowed her to re-emerge as Joe Biden’s treasury secretary—just when she thought she was done with public life. She has at times seemed to be on the

margins of his cabinet. On a few crucial issues, though, she has shone. With a flair for diplomacy, she brought more than 130 countries together last year in a deal to establish a minimum tax on companies around the world (alas, international agreement has proved easier than assent from Congress).

Ms Yellen has a knack for being right about the big picture. She was early in detecting signs of recklessness in the American housing market in the 2000s, even if she later faulted herself for not grasping the enormity of the problem. In the early 2010s she was adamant, correctly, that the central bank should stick to very loose policy to propel the economy's sputtering recovery. The darkest blot on her record was her support for the stimulus package that Mr Biden introduced at the start of his presidency, which ended up adding fuel to inflation. Ms Yellen had initially been uncomfortable with the size of the stimulus, though she eventually defended it.

Ms Yellen granted considerable access to both writers, but there are gaps to fill in each account. The books hint at her immense frustrations in dealing with Mr Trump. They also refer to her being sidelined from time to time by both the Clinton and Biden administrations. Given her attention to detail, it is reasonable to assume that Ms Yellen has copious notes on all of this. Rumours abound that she may step down soon from the Treasury. That would be America's loss, yet one good thing might come of it: getting her story in her own words. ■



钱随她舞动

两本新传记探究了珍妮特·耶伦的发迹和掌权之路

这位美国财政部长以其巨细靡遗和“道德热情”闻名【《耶伦传》、《同理心经济学》书评】

《耶伦传》，乔恩·希尔森拉斯著。Harper Business；400页；32.50美元/25英镑。

《同理心经济学》，欧文·厄尔曼著。PublicAffairs；480页；32美元/25英镑。

珍妮特·耶伦（Janet Yellen）很可能是过去25年来世界上最有权力的女性。上世纪90年代末，她在克林顿政府出任经济顾问委员会主席。2000年代，她在美联储担任了一系列职务，在2014年晋升主席。过去两年她的身份是财政部长。她是唯一一个担任过这三项职务的人，几十年来对美国乃至全球经济发挥着影响力。

要说她拥有的权力有什么最显著的特点，那可能是这一切竟然几乎没有改变她这个人——她依然是那个怀揣着道德指南针的学究气的经济学家。不管是她的同事还是下属都认为她本质正派，恪尽职守维护公共服务的价值。她始终一丝不苟地忠于证据，而不是意识形态——乃至有时损害了她的职业生涯，至少曾短暂损害过。她似乎决意不在华盛顿这个最政治化的城市里玩政治游戏。

不爱出风头的耶伦如何能够平步青云？她又取得了什么成就？这是两本新传记提出的问题。《华尔街日报》的乔恩·希尔森拉斯（Jon Hilsenrath）所著《耶伦传》（Yellen）不只追踪了她的人生轨迹，还有她丈夫乔治·阿克洛夫（George Akerlof）的。阿克洛夫也是一位经济学家，还是诺贝尔奖得主。这本书行文优美，见识广博，记述了这对伉俪追寻“市场有可能失灵，而明智的政府行为可以改善人的生活”这一理念的学术旅程。这看起来可能平庸老套，但在当年他们初出茅庐时却很有争议

性，是对20世纪70年代席卷了经济学理论的自由放任主义信条的反驳。资深记者欧文·乌尔曼（Owen Ullmann）的《同理心经济学》（Empathy Economics）对耶伦的轨迹做了更直白、更紧凑的叙述，其中夹杂了大量来自其同事和友人的评论。

那么，是什么造就了耶伦那令人敬畏的职业生涯？有一点很突出，她周围的人都了解，那就是她对大大小小的事务都会做好万全的计划。她会提前好几个小时到达机场，经常第一个到达候机室。在以财政部长的身份将正式签名印上纸币之前，她回顾了前几任部长的笔迹，并反复练习自己的签名。担任美联储主席时，她会花三天时间为季度新闻发布会做准备，让工作人员向她抛出所有能想到的问题。可能有点严谨过头了。然而在男性主导的经济学领域，做会议席上准备最充分、通常也是知识储备最丰富的那个人让她获得了成功。

耶伦受她自己所说的“道德热情”的鼓舞——她认为经过了恰当分析和应用的经济学会让世界变得更美好。不管是身为学者还是政策制定者，她主要关注的都是如何降低失业率。“这些可他妈都是活人啊！”在美联储一次关于失业的抽象讨论中，她大声说道。她还以诚实正直著称，例如在2017年任美联储主席时的一次演讲中，她为严格的银行监管辩护，不惜冒着激怒特朗普的顾问的风险，后者一心想淡化监管规则。这一下她的命运已定，再加上特朗普似乎觉得身材矮小的耶伦没有央行行长该有的样子，他拒绝让她连任美联储主席。

但是，就在她以为自己的公共服务生涯到此结束时，就是这种正直加上她强大的才智让她东山再起，成为拜登的财政部长。在拜登的内阁中，她有时似乎处于边缘。不过在一些关键问题上，她大放光彩。凭借外交天赋，她在去年召集了130多个国家，商定了对全球企业征收最低税（唉，事实证明，达成国际协议要比在美国国会通过议案容易）。

耶伦擅于把握大局。她很早就发现了本世纪初美国房地产市场的鲁莽迹象，尽管她后来自责没有意识到问题的严重性。2010年代初，她坚定地认为央行应该坚持非常宽松的政策，为经济缓慢乏力的复苏提供动力。她是

对的。她的履历中最严重的污点是支持拜登在其总统任期开始时提出的刺激方案，该方案到头来加剧了通胀。耶伦起初对刺激计划的规模感到不安，但最终选择为之辩护。

耶伦为两位作者都提供了相当多的素材，但两部传记都留下了待填补的空白。它们暗示她在与特朗普打交道时感到无比沮丧，还提到她在克林顿和拜登政府中不时被边缘化。鉴于她如此注重细节，我们有理由假设关于这一切她留有丰富的记录。说她可能很快从财政部退下的传言不绝于耳。这将是美国的损失，但仍可能成就一件好事：让她用自己的话讲述自己的故事。■



Bartleby

Elon Musk's challenge to management thinking

If the billionaire succeeds at Twitter, the MBA will need an update

ELON MUSK'S takeover of Twitter raises questions of policy: is it right for the world's richest man to own such an important forum for public debate? It raises issues of law: is his decision to get rid of so many workers within days of completing the acquisition above board? And it raises questions of strategy: can Twitter make money by moving from a business model based on advertising to one based on subscription? But it is also an extremely public test of a particular style of management. In the way he thinks about work, decision-making and the role of the CEO, Mr Musk is swimming against the tide.

His attitude to employees is an obvious example of his counter-cultural approach. For a futurist, Mr Musk is a very old-fashioned boss. He doesn't like remote work. Earlier this year he sent an email to employees at Tesla demanding that they come to the office for at least 40 hours a week. Anyone who thought this was antiquated could "pretend to work somewhere else", he tweeted.

Whatever the legality of his decision to fire so many Twitter workers, his methods are brutal: people locked out of corporate IT accounts, careers ended with an impersonal email, half the workforce gone at a stroke. It is as if Thanos had decided to try his hand at business. For those who remain, hard graft is the expectation; insiders say that one of Mr Musk's first acts at the firm was to cancel monthly firm-wide "days of rest". The template for the modern manager tends to be a low-ego, compassionate boss who gives people autonomy. Someone didn't get the memo.

His critics have to accept that the my-way-or-the-highway approach has

worked before. At his other firms, like Tesla and SpaceX, Mr Musk may not have offered empathy but he has provided a planet-sized sense of purpose, from popularising electric vehicles to colonising Mars. Whether this can work for him at Twitter is less clear. His vision for the product as a “digital town square” where free speech flourishes is a typically grand one. This time, however, he is not taking on lumbering incumbents, but fixing an existing business where judgment and politics matter as much as engineering.

The way that Mr Musk takes decisions also cuts across consensus. Comparatively little research has been done on how CEOs make their choices, but a Harvard Business School working paper published in 2020 had a bash by asking 262 of the school’s own alumni how they went about making strategy.

The authors of the paper did discover a wide range of approaches, with some managers going on gut instinct and others using very formalised processes. But the researchers found that bosses who use more structured processes tend to lead bigger and faster-growing firms (which way causality runs is not clear). They also tend to make decisions more slowly. Mr Musk and his acolytes are in a different camp: fast, informal and aggressive. Reports are already surfacing of fired Twitter workers being asked to come back.

He is unorthodox in another way, too. Peter Drucker, a doyen among management thinkers, described the CEO as being the person in the organisation who bridges the outside world and the inner workings of the company. No one else in the firm is in a position to combine these perspectives, Mr Drucker wrote.

Mr Musk is not so much bridging this gap as making the distinction between the inside and outside of the company irrelevant. His personal

brand and wealth is inextricably linked with the other firms he runs. At Twitter he is going even further, tossing out product ideas on his own Twitter feed, polling the audience for their views and offering real-time commentary on how things are going. And Twitter itself is a platform on which everyone—users, ex-employees, the people who founded the firm, policymakers and pundits—weighs in publicly to say how things are going. There is not much of an inside to talk of.

You might object that Mr Musk is a one-off, and so is this deal. When he first made his offer to buy Twitter, he explicitly said that it was not because of an economic rationale. He later tried to wriggle out of the transaction entirely. The story of a billionaire owner of a social-media platform has little in common with the challenges that preoccupy the salaried executives of most public firms. Maybe so, but if Mr Musk makes another success of his latest venture by being brutal to his workforce, skipping the PowerPoint sessions and managing through memes, the MBA will still need a bit of an update. ■



巴托比

马斯克挑战管理思想

假如这位亿万富翁成功改造了推特，MBA课程要修订了

马斯克收购推特引发了政策争议：如此重要的公共辩论平台让世界首富收为己有，这对吗？还有法律争议：他在完成收购后几天内就解雇了这么多员工，这正当合法吗？再有是战略争议：把商业模式从基于广告转向基于订阅能让推特盈利吗？而同时这也是对一种特殊管理风格的极度公开的测试。从马斯克对工作、决策和首席执行官角色的想法看，他是在逆流而行。

他对员工的态度就是他逆主流文化的明显例子。作为一名未来主义者，马斯克实在是个非常守旧的老板。他不喜欢远程工作。今年早前，他给特斯拉的员工发了一封电子邮件，要求他们每周到办公室工作至少40小时。觉得这很过时的人都可以“到别的地方装模作样地工作”，他发推说。

不管他解雇这么多推特员工的决定是否合法，执行方式都是残酷的：突然把员工移除出公司的IT账户，用一封没什么人情味的电子邮件把人辞退，就这么一下子撵走了半数员工。仿佛是灭霸决意到商界露一手一般。至于留下来的员工，等待他们的也是苦差；内部人士称，马斯克上任的第一把火是取消了全公司每月的“休息日”。现代管理者的模范往往是那种不那么自大、有同情心、对员工放权的老板。有人没听进去。

他的批评者不得不承认，他那套“不听话就滚蛋”的做派之前很好用。在他的其他公司，如特斯拉和SpaceX，马斯克也许没有展现同理心，但他让员工生发出天大的使命感，从普及电动汽车到殖民火星。这在推特上是否好用就不那么清楚了。他的愿景一如往常的宏伟，要把推特打造为一个言论自由的“数字城市广场”。然而这一次他不是挑战行动迟缓的老牌企业，而是要改造一项现有业务，其中不仅涉及工程技术，判断力和政治触觉也同样重要。

马斯克的决策方式也是绕过共识机制的。关于CEO如何做决策的研究相对较少，但哈佛商学院在2020年发表的一篇工作论文做了一番探讨，访问了该校262名校友，调查他们如何制定战略。

这篇论文的作者发现，管理者的决策方式各式各样，有的凭直觉行事，也有的非常讲究规范流程。但研究人员发现，那些采用更结构化的流程的老板往往掌管着规模更大、增长更快的公司（两者孰因孰果不甚清楚），他们的决策速度往往也更慢。马斯克和他的信徒属于另一个阵营：快、狠、随性。已有报道称，有些被解雇的推特员工又被请了回去。

在另一方面，马斯克也显得离经叛道。管理思想大师彼得·德鲁克（Peter Drucker）认为CEO是组织中连接外部世界和公司内部运作的人。公司中再无其他位置上的人能汇聚这多方视角，德鲁克写道。

而马斯克，与其说他是在弥合公司内部和外部的隔阂，不如说他是在让两者的区隔变得不再重要。马斯克的个人品牌和财富与他经营的其他公司密切相连。在推特，他甚至更进一步，在自己账号上发文抛出产品创意、调查受众意见，实时评论事情进展。而推特本身就是一个供众人（用户、前雇员、推特创始人、政策制定者、专家权威）公开谈论事情发展的平台。这里没什么内部可言。

你可能反驳称，马斯克这个人绝无仅有，他对推特的收购也是如此。在最初出价收购推特时，他就明确表示并非出于经济考虑。后来他又一度想完全退出收购。一名亿万富翁拥有一个社交媒体平台的故事和大多数上市公司的领薪高管所面临的挑战大不相同。也许如此。但如果马斯克能靠着向员工发狠、不用PPT简报、以发推玩梗做管理取得又一次成功，那么MBA课程还是需要修订一下的。■



The big and the little

Small climate projects cannot take the place of all large ones

But they can achieve a lot if coordinated

CANUTE, LEGEND has it, ordered the rising tide to turn back. The tide did not comply. Some say the king—who ruled large parts of England, Denmark and Norway in the 11th century—overestimated his power, others that he was deliberately demonstrating its limits to obsequious courtiers. Either way, all agree that the tide was not to be turned on the say-so of secular authority.

An alternative reading is that Canute was undercapitalised. This is the interpretation written in earth, concrete and steel at the mouth of the River Maas in the Netherlands. The Maas, as the Rhine's main outlet into the North Sea, provides shipping with access to Rotterdam, far and away Europe's busiest port. Unfortunately it provides access for storm surges, too, and much of Rotterdam and the surrounding country are below sea level. Seas are rising; the extremes of rainfall in northern Europe are getting worse. So is the risk that a storm-swollen tide might surge up an overflowing Maas, overwhelm lesser dykes and swamp the city.

The most spectacular part of the Netherlands' response is the Maeslantkering—two vast but hollow metal barriers, mounted on even bigger steel arms, which can be swung together to seal off the river from the North Sea when the water is dangerously high. Those gates, built in the 1990s, were designed to cope with anything up to a 1-in-10,000-year extreme event. The circumstances that would merit their closure were expected on average just once every ten years. Twenty-five years on they have yet to be seen even once. But they are coming, and more frequently than the designers thought. With 35cm (14 inches) of sea-level rise—which is in the likely range for 2050—the average time between closures is

expected to halve. In a world which sees 85cm of rise—in the likely range for 2100—they could become annual events.

The Maeslantkering cost €450m (\$490m in the 1990s, which is \$920m in today's money). But that was hardly a crippling expense for a government whose annual tax take at the time was €136bn. Flood-defence levies charged to residents and businesses comprise roughly 2% of the overall tax burden, or less than 1% of GDP. Whereas the cost of the government's plans to curb greenhouse-gas emissions causes widespread grumbling, there is almost no carping about the money spent on adaptation. Indeed, it is a matter about which most citizens feel some pride.

The foresight involved was, as is often the case, a function of past trauma. In 1953 a storm surge killed almost 2,000 in the country and flooded 9% of its land; the Maeslantkering was the culmination of decades of engineering aimed at preventing a recurrence. In a similar way, if not as effectively, America began paying more attention to its flood defences after a similar number died in New Orleans at the time of Hurricane Katrina. It took 15,000 deaths in the ferocious heatwave of 2003 for France to set up a network of air-conditioned civic centres where people could shelter rather than stifle. In 2011 a torrential cloudburst in Copenhagen caused almost \$1bn in damage in a couple of hours; only then did the Danish authorities rethink how the city's drains should work.

To be able to respond to big risks with big engineering is one of the benefits of affluence. But it is not always an optimal response, and it can be a damaging one. Sea defences are a case in point. They can be vital; but they are freighted with risks of what experts call “maladaptation”—responses to climate change which simply redistribute, or sometimes increase, the risks which it poses. One problem is a false sense of security. Sea and flood defences which are good enough for the next ten years but not the next 50 encourage people to stay, and invest, in areas that are still at long-term risk.

Then there is partiality. Protection that helps one part of a city at the expense of another may lead to the rich getting the lion's share of the benefits and the poor being forced into the riskiest areas. And there are the risks of not thinking in a joined up manner—concentrating on a particular aspect of the problem at hand in a way that ignores, or even exacerbates, others.

A good rule of thumb is that projects touted as solutions in and of themselves are peculiarly prone to such problems. Take Jakarta, the capital of Indonesia. Its 11m people live on a coastal plain criss-crossed by rivers and canals which is sinking because of the amount of water being removed from the ground below it. Some 40% is already below sea level.

| *How to stop a city sinking*

The previous city government had planned to reduce the growing flood risk with a series of artificial islands off the coast in the shape of a garuda, a mythical bird that is Indonesia's national symbol. It was to have been at the same time a protection against storm surges and a catalyst for development. Its total cost, estimated at \$40bn, was to be borne mostly by private developers.

Anies Baswedan, Jakarta's governor from 2017 to this October, had two misgivings. The project would cause the city's sewage, most of which is not treated, to collect in the shallow water behind the barrier—an ecological disaster. And a vast seaside development of "Dubai-style, pricey mansions", in the words of an adviser, Tom Lembong, would only heighten the already yawning gulf between rich and poor in the city.

So Mr Anies cancelled the scheme and focused on much cheaper measures instead. First, he took advantage of a gradual expansion of the city's water mains which had been under way since long before he became governor to levy swingeing fees to those who pumped water up from below for their

own use. To sort out some of the distributional problem which followed he started sending trucks full of water to poor neighbourhoods that are not served by the municipal pipes.

Mr Anies also ordered the drilling of 29,000 “vertical drains” through which rainy-season floodwater could recharge the aquifer. Sluices in more elevated parts of the city are now temporarily closed to help keep water away from low-lying areas during storms, providing a few hours’ water storage. And developers have been kept away from the city’s last few low-lying green spaces, so that they can continue to act as sponges. The only big, conventional engineering project Mr Anies has retained is a modest dyke which is expected to cost about \$6m.

Subsidence has slowed sharply in most of the city and stopped in some of it. Does that make Jakarta sea-level-rise ready? No. But it is better off than it was. And it has demonstrated the most promising way of thinking about adaptation: as something that builds on and is built into other forms of development, which can benefit from private investment, such as in water mains, and which involves lots of small things as well as a few big ones.

| *Sous les pavés, l’adaptation*

Vidhisha Samarasekara of the International Water Management Institute says that the best way to protect people from flooding is typically routine maintenance and planning coupled with detailed mapping which locates the most flood-prone spots. The Dutch would probably agree; their capacity for very large projects does not lead them to discount the power of micro ones. Rotterdam is keen on “green roofs” from which water drains more slowly than from tile and tin and tegelwippen—the prising up of paving stones in order to expose, and garden, absorbent soil beneath. It takes pride in the fact that last year it prised up 47,942 paving stones to Amsterdam’s 46,484.

One of the reasons that adaptation needs to be piecemeal, even when well planned, is that climate risks and impacts are not something that can be set aside from the rest of life. A wide range of factors will determine who is at risk of what; climate change will rarely be completely dominant.

Take fires in the west of the United States. Even adjusting for inflation, eight of the ten most expensive fires, in terms of insured property destroyed, have occurred since 2017, according to the Insurance Information Institute, an industry body. This is in part because of hot summers during an unprecedented megadrought. But there are lots of other factors, such as where people choose to live, how they get insured, and what has been done previously to keep the risks low. Stopping all small fires so that the fuel available for big ones builds up is a textbook piece of maladaptation.

The most obvious way to deal with big fires is to put more effort into fighting them. In 2021 the federal government spent \$4.4bn putting out wildfires, largely through the Forest Service, double what it spent in 2020. State and local governments are also boosting spending. Growing effort and investment is being put into prevention, too. California's annual budget for that is more than \$1.5bn. The governor has proposed boosting it further.

According to Michelle Medley-Daniel of the Fire Adapted Communities Learning Network, the main impediment to reducing the damage from wildfires is not a lack of funds, but the diffusion of responsibility and know-how among many different groups, from the federal government to Native American tribes. Her network is trying to remedy that by disseminating information about how settlements can best protect themselves.

The forms of prevention being adopted vary from place to place, notes Ms Medley-Daniel, depending on the size and preferences of the local

community and the ecology of the surrounding countryside. But it tends to be a mixture of emergency planning, to make sure not just humans but also livestock, say, escape fires; efforts to impede future conflagrations, by creating firebreaks, perhaps, or clearing or burning undergrowth that can act as tinder; and measures to help buildings resist the flames, by preventing sparks from getting into heating vents, for instance.

Alarmed property owners, insurers, different levels of government and all manner of NGOs are getting involved. The Fire Adapted Communities Learning Network helps promote prescribed burning, in which neighbours band together to set and control fires to burn off undergrowth. The state of California, for its part, is constantly revising and tightening its building codes, which have special requirements for fire-prone areas. It has also just promulgated regulations that will oblige insurers to reduce premiums for homeowners and businesses that take steps to fireproof their property. The state government did so in part because insurers have been charging higher premiums in fire-prone spots—itsself an adaptation-promoting signal to property-owners.

It is all a bit of a hodgepodge, and will doubtless take some time to take effect. But those most at risk of fire now have a variety of incentives and means to adapt. There will still be big, destructive, costly fires in future, but the damage will be much less than it otherwise might have been. In other words, fires will remain a risk of living in California, rather than a bar to it.

At the moment, the same is true for floods in Bangladesh. Even were there the means, there is no way of protecting its vast coastal plains and islands with hard defences. But as Kristalina Georgieva, head of the IMF, points out, each district has at least one flood- and cyclone-proof building in which residents and their livestock can shelter during storms. And there is a well developed warning system that tells people when to use them.

As a result the terrible impact of Bhola, a cyclone which drowned 300,000 people in 1970, is all but unthinkable today. The persistent policy push which has seen these redoubts made universal not only saves lives by the tens of thousands, but hugely diminishes the economic damage of similar storms. Since the buildings are typically used for something else during clement weather (as schools, say), the only additional cost to the government has been that of ensuring they are robust enough.

More recently, a government make-work scheme for poor households has been paying workers to raise homes onto small earth mounds or concrete slabs above the flood line, with similar benefits. None of this means that Bangladesh can face the rising seas with equanimity. But it might have given Canute's fawning courtiers an idea of what prudent government looks like. ■



大和小

小型气候项目无法替代所有大工程

但如果协调运作，就可以取得很大的成效【专题《时代的挑战》系列之三】

传说克努特命上涨的潮水褪去。潮水抗命。有人说这位在11世纪统治了英格兰、丹麦和挪威的大片地区的大帝高估了自己的权力。也有人说他是故意在向谄媚的朝臣展示自己权力有限。无论如何，所有人都同意，潮水不会为凡间权威的一声令下而掉头。

另一种解读是克努特资金不足。这是荷兰的马斯河（River Maas）河口用泥土、混凝土和钢材写就的诠释。作为莱茵河进入北海的主要出口，马斯河提供了通往欧洲毋庸置疑的第一大港鹿特丹的航运通道。不幸的是，它也为风暴潮提供了路径，而鹿特丹及其周边的大部分地区都低于海平面。海平面正在上升；北欧的极端降雨在恶化。同样在上升的风险是暴风雨引发的潮水急速涌上漫溢的马斯河，冲垮较小的堤坝，淹没这座城市。

在荷兰的应对措施中，最宏伟壮观的部分是马仕朗防风暴大坝

（Maeslantkering）。这是两块中空的巨大的金属屏障，被安装在更大的两条钢臂上。当水位涨至危险高位时，两条钢臂摆动合拢，将马斯河和北海隔断。这些闸门建于1990年代，旨在应对万年一遇的极端风暴。预计平均每十年才会需要关闭它们一回。25年过去了，却一次都还没发生过。但它们快要来了，而且会比设计师当年想象的更频繁。如果海平面上升35厘米——这在2050年的预计范围内——关闭它们的平均间隔将减半。在一个海平面上升85厘米（在2100年的预估区间内）的世界里，可能每年要关闭一次。

这座大坝耗资4.5亿欧元（在1990年代合4.9亿美元，相当于今天的9.2亿美元）。但这对于一个当时年税收1360亿欧元的政府来说不是什么了不起的开支。向居民和企业收取的防洪税约占总税赋的2%，不到GDP的1%。尽管荷兰政府遏制温室气体排放计划的成本引发了广泛不满，却没什么人抱怨花在适应措施上的钱。事实上，大多数荷兰公民还颇为这类项目自豪。

和常见情况一样，先见之明是用过去的创伤换来的。1953年，一场风暴潮在该国造成近2000人死亡，淹没了9%的土地。马仕朗大坝是之后几十年里为防止灾难重演而开展的工程的顶点。同样地，在卡特里娜飓风在新奥尔良造成差不多数量的人员死亡后，美国开始更加重视防洪设施，尽管成效不及荷兰。在2003年的凶猛热浪导致1.5万人丧生后，法国才部署了带空调的市民纳凉网点，让人们可以躲避酷热窒闷。2011年，哥本哈根的一场大暴雨在短短几小时内造成了近10亿美元的损失，丹麦当局终于开始反思这座城市的排水系统该如何运作。

能用大工程应对大风险是富裕的好处之一。但这并不总是最佳应对，甚至还有可能是破坏性的。海防是一个很好的例子。它们可能至关重要，但充满了专家称之为“适应不良”的风险，也就是说，应对气候变化的手段只是重新分配了——或者有时是增加了——它带来的风险。一个问题是虚假的安全感。有些海防等防洪设施适用于未来10年，但对未来50年而言还不够用，却会让人们留在仍有长期风险的地区并进行投资。然后是不公平的问题。以牺牲城市的一部分地区来帮助另一部分地区的保护措施可能会导致富人受益最多，而穷人被迫进入最高风险区。此外还有缺乏全局观的风险——专注于手头问题的特定方面而忽视甚至加剧了其他方面。

一个好的经验法则是，那些被吹捧为可凭一己之力一举解决问题的项目特别容易出现上述问题。以印尼首都雅加达为例。它的1100万人口生活在一个河流和运河纵横交错的沿海平原上，由于地下水被过度开采，它正在下沉。大约40%的区域已经低于海平面。

| 如何阻止一座城市下沉

上届特区政府曾计划在海岸线附近建造一系列人工岛屿以降低日益加剧的洪灾风险。这些岛屿要建成国家吉祥神鸟迦楼罗（garuda）的形状。它们本来是要同时充当抵御风暴潮的屏障和经济发展的催化剂。预估总成本为400亿美元，主要会由私人开发商承担。

自2017年到今年10月担任特区首长的阿尼斯·巴斯威丹（Anies Baswedan）对此有两方面的顾虑。该项目将导致城市污水（其中大部分

未经处理）聚集在这道屏障后的浅水区，引发生态灾难。此外，顾问汤姆·伦邦（Tom Lembong）口中的“迪拜式昂贵豪宅”大规模滨海开发项目只会加剧这座城市本已严重的贫富差距。

所以阿尼斯取消了这个方案，转而专注于成本低得多的措施。首先，他利用早在他上任前很久就在逐步扩建的城市水管网络，向那些自行抽取地下水的人征收高昂费用。为解决随之而来的一些分配问题，他开始把装满水的卡车派遣到没有市政管道覆盖的贫困社区。

阿尼斯还下令钻探2.9万个“垂直排水沟”，雨季的洪水可以经由这些排水沟回灌含水层。该市地势较高地区的泄水道目前已暂时关闭，以在暴风雨期间提供几小时的蓄水缓冲，让水远离低洼区。此外，开发商一直不被允许动用该市最后几块低洼绿地，这样它们就可以继续充当吸水海绵。阿尼斯唯一保留的大型传统工程是一座规模不大的堤坝，预计耗资600万美元左右。

该市大部分地区的沉降已经急剧放缓，在部分区域已经停止。这是不是说，雅加达已经为海平面上升做好了准备？不是。但情况比以前好了。它也展示了最有前景的“适应”思路：视之为建基于其他发展形式之上并且镶嵌于其中的事务，可以从私人投资中受益，比如在自来水管网中就是如此；除了少数大工程，它还涉及很多小项目。

| 路面之下，是适应

国际水管理研究所（International Water Management Institute）的维迪沙·萨马拉塞克拉（Vidhisha Samarasekara）说，保护人们免受洪灾的最佳方法通常是日常维护和规划，并结合详细的地图确定最容易淹水的地点。荷兰人可能会同意这一点，他们在宏大项目上的能力并没有令他们低估微型项目的作用。鹿特丹目前热衷于用“绿色屋顶”来让雨水径流速度比瓷砖和锡皮屋顶更慢，还有“挪走铺路石”——暴露出下方的吸水土壤并种植花草。该市很自豪去年它总共移除了47,942块铺路石，多于阿姆斯特丹的46,484块。

即使规划周密，适应措施仍需要零敲碎打。原因之一是气候风险及影响并不独立于生活的其余方面。各种各样的因素将决定谁会面对什么风险，气候变化很少会完全占据主导。

以美国西部的山火为例。根据行业机构保险信息研究所（Insurance Information Institute）的数据，即使在经通胀调整后，以被破坏的受保财产计算，十次损失最大的火灾有八次是在2017后发生的。部分原因是 在一个前所未有的特大干旱期中的炎夏高温。但还有很多其他因素，例如人们选择住在哪里，他们如何获得保险，以及以前做了些什么来保持低风险。防止了所有小火灾，却为大火灾积蓄了燃料是适应不良的教科书式案例。

处理大火灾最显而易见的方法是投入更多力量来扑灭它们。2021年，联邦政府花费了44亿美元，主要通过林务局扑灭山火，比2020年的支出翻了一番。州和地方政府也在增加支出。对预防的投入也与日俱增。加州这部分年度预算超过15亿美元，州长已提案进一步提高它。

火灾适应社区学习网络（Fire Adapted Communities Learning Network）的米歇尔·梅德莱-丹尼尔（Michelle Medley-Daniel）认为，减少山火损害的主要障碍并不是缺乏资金，而是在许多不同的群体之间（从联邦政府到原住民部落）分散了责任和专业知识。她的网络尝试传播有关住宅区如何能最好地自我保护的信息来改善状况。

梅德莱-丹尼尔指出，各地采取的防预形式各不相同，具体取决于当地社区的规模和偏好以及周围乡村的生态，但往往都会结合以下几种形式：应急计划，以确保人和牲畜等都能及时逃离火场；遏制未来发生的山火，可能是通过设置森林防火隔离带，或者清除或焚烧易燃的灌木丛等；还有帮助建筑物抵御火灾的措施，例如防止火花进入供暖风口。

警觉起来的业主、保险公司、各级政府和各式非政府组织正纷纷参与其中。梅德莱-丹尼尔的学习网络帮助促进按规定实施燃烧，也就是邻里联手焚烧灌木丛并管控焚烧过程。加州正在不断修订和收紧建筑规范，对火灾易发地提出特殊要求。它还刚刚颁布了法规，将要求保险公司对那些改

善房屋防火能力的房主和企业降低保费。州政府这样做的部分原因是保险公司过去一直对火灾多发地收取更高的保费——这本身也是向业主发出的敦促适应的信号。

这有点像一锅大杂烩，无疑需要一些时间才能显现效果。但是那些最有可能遭遇火灾的人现在有了各种动力和方法来进行适应。未来仍会发生大规模、破坏性和代价高昂的火灾，但损失会比原本可能的情况小得多。换言之，火灾将仍是在加州生活的风险，但不至于成为一种阻碍。

目前，孟加拉国的洪水也是这样。即使有足够的资金，也不可能用硬防御来保护其广阔的沿海平原和岛屿。但正如国际货币基金组织（IMF）的负责人克里斯塔利娜·格奥尔基耶娃（Kristalina Georgieva）指出的那样，该国的每个地区都至少有一座防洪和防飓风的建筑物，供居民和他们的牲畜在暴风雨中避难。此外它还有一个成熟的预警系统，告知人们何时需要使用这些庇护所。

其结果是，在1970年造成30万人溺毙的波拉热带气旋的可怕影响在今天几乎已不可想象。持续的政策推动使庇护所变得普遍，不但挽救了几十万条性命，也大大减少了类似的风暴导致的经济损失。由于这些建筑物在天气晴朗时通常都用作他途（例如学校），政府唯一的额外成本是确保它们足够坚固。

更近些时候，一项针对贫困家庭的政府补贴就业计划也带来了类似的益处。它雇请工人把房屋抬高，下方垫上高于洪水水位线的小土堆或混凝土板。所有这些并不意味着孟加拉国已经可以泰然自若地面对不断上升的海平面了，但可能让那些谄媚克努特的朝臣们了解一下，一个审慎的政府是什么样的。■



Look around you

The business of businesses is climate-change adaptation

Big ones are waking up to the fact

IT CAN CLIMB stairs, check gauges and send reports. When it's not busy with work, it takes itself off to its quarters, to rest. It never needs food or water, and can plug itself in to recharge. And although it doesn't like sandstorms any more than people do, it knows how to batten down the hatches and wait them out.

Spot is a bright yellow robotic dog designed by Boston Dynamics, an American engineering firm, and deployed at a remote natural-gas-pumping station in the middle of a desert by Saudi Aramco, Saudi Arabia's state-controlled oil giant. It is not a great place for a human being to hang out: in addition to the sand whipped up by the unobstructed winds, there is blistering sunshine and nothing to drink or eat for miles around. For Aramco's managers, the fact that climate change is making all this worse is almost beside the point: Spot's pumping station was always a place where any human presence should be kept to a minimum.

Spot is not an explicit adaptation to climate change, but rather part of an existing programme to reduce the danger and expense of certain tasks using robots. Aramco also has drones that can inspect smokestacks, unmanned submarines that can conduct seismic surveys on the seabed and mechanical "pigs" that can crawl along pipes. Other oil companies are doing much the same, deploying robo-dogs of their own on platforms in the North Sea and the Gulf of Mexico, for instance.

Businesses must always plan ahead and try to anticipate problems, in spite of the big uncertainties that entails. Public companies, moreover, have shareholders, often including environmental activists, who tend to ask

pesky questions about climate. And then there are regulators, trying to make sure that businesses get to grips with big problems so that the responsibility does not wind up with the government.

The result is that big corporations, at least, are talking about climate change, giving thought to how it affects their operations and planning how to adapt.

For some, the need is blatant. The region in and around London in which Thames Water, Britain's biggest water utility, operates, is getting hotter, and although the overall level of rainfall appears stable, it comes in more intense bursts, with longer dry spells in between. That means that Thames has to invest to cope with both more deluges and more droughts.

On the drought side, the company has big plans to plug leaks and to curb demand by installing meters. It will also use an aquifer south of London as a reservoir, pumping water in when it is abundant and out during dry periods, and divert some water from the Severn, a big river outside its service area, using the existing canal network. It also plans to start re-using some of the water that emerges from its sewage plants.

The main answer to the deluges is the "super-sewer", as Londoners have dubbed it, a seven-metre-wide, 24km-long tunnel that Thames will manage when it is completed in 2024. The £4.9bn (\$5.7bn) tube, which stretches across the city from west to east, will act as a vast overflow drain when cloudbursts overwhelm the normal sewer system. (London's sewage pipes double as storm drains, a design choice made in the 1860s that is now almost impossible to undo.) All the company's sewage plants and pumping stations have been assessed to judge whether they, too, are at risk of flooding.

To ensure adequate water supply as far off as 2100, Thames has mapped out

a series of “adaptive pathways” which depend on climate change, demography and the economy. Its investments are informed by exhaustive planning and forecasting, using low-, medium- and high-emissions scenarios for the 2020s, 2050s and 2080s, at multiple levels of confidence. And all that despite the fact that, even for Thames, climate change is not the most decisive factor in its investment decisions. Half the shortfall in water supply it foresees by 2045 without extra investments is down to change in demand, largely due to population growth. Climate change only accounts for a quarter.

Even in industries less obviously affected by climate change, big business is taking adaptation seriously. Unilever, a multinational consumer-goods firm, has tried to quantify the likely impact of climate change on its results in 2030, 2039 and 2050 under three different regulatory scenarios and a range of different temperature increases. This obviously matters to the bottom line.

| *Give the owners what they want*

Unilever’s latest annual report discusses both the possibility of a €6.4bn boost to annual profits in 2050 from seizing on growing demand for vegan and vegetarian food and the possibility of a hit of €6.1bn if a carbon tax were imposed on its emissions across the board. It also helps it plan adaptation strategies aimed at both direct impacts of climate change and at systemic issues they exacerbate: stricter regulation of agriculture, higher energy prices, growing water scarcity and rising prices for commodities.

Unilever has laid out plans to relocate manufacturing if particular plants are damaged by extreme weather and has lined up emergency suppliers if supply-chains are disrupted. It is developing longer-term contingency plans, too, such as making its shampoos quicker to rinse, in case its customers are obliged to curb their use of water. Most of its dishwasher detergent works in cold water, in anticipation of a world where energy is

much pricier.

If maintaining profits were not incentive enough to adapt to climate change, there is also external pressure. Environmental activists tend to be concerned mainly with reducing emissions, which climate wonks call mitigation. But for most investors, or at least longer-term ones, adaptation is also important. Both Thames Water and Unilever detail the steps they are taking to adapt in their annual reports in part because they follow the recommendations of the Task-force on Climate-Related Financial Disclosures (TCFD).

The task-force is an outgrowth of the Financial Stability Board, an international body that seeks to avoid future financial crises through sounder regulation. Companies with a combined market capitalisation of \$27trn have signed up to its standards, TCFD says. Regulators in eight jurisdictions, including Britain and the European Union, require public companies to comply with different parts of its guidelines. Businesses dislike alerting investors to gaping potential flaws in their plans, so the act of disclosing such risks spurs adaptation.

Smaller companies cannot afford to hire consultants to sketch out future-climate-change scenarios and make adaptation plans for 1.5°C, 2°C and 4°C of change. Unlisted ones do not face as much pressure to do so. But they also tend to have less sprawling empires, and so a clearer idea of what the future might have in store. And big or small, public or private, businesses tend to have an unrelenting focus on their own survival. For small businesses in the developing world, and certainly for poor individuals, the problem is not a lack of willingness to adapt, it is a lack of capital. ■



看看你周围

企业的任务是适应气候变化

大公司正在意识到这一事实【专题《时代的挑战》系列之一】

它可以爬楼梯、检查仪表并发送报告。不忙活时，它会回到自己的住处休息。它从不需要食物或水，并且可以自行充电。虽然它像人类一样不喜欢沙尘暴，但它知道如何做好准备并等待风暴过去。

Spot是一条亮黄色的机器狗，由美国工程公司波士顿动力（Boston Dynamics）设计。沙特阿拉伯的国家控股石油巨头沙特阿美公司（Saudi Aramco）把它部署在沙漠中一个偏远的天然气泵站。对于人类来说，这不是一个闲逛的好去处：除了畅通无阻的风吹起的沙子外，还有炽热的阳光，而方圆数英里内没有任何地方可以吃喝。对于阿美的管理人员来说，气候变化正使这一切变得更糟这一点几乎无关紧要：Spot的泵站反正总是一个应该把人迹保持在最少的地方。

Spot并不是纯粹是为了适应气候变化而来到这里。它是一个现有计划的一部分：利用机器人来降低执行某些任务的危险性和成本。沙特阿美还拥有可以检查烟囱的无人机、可以在海床上进行地震勘测的无人潜艇，以及可以沿着管道爬行的机械“猪”。其他石油公司也在做同样的事情，例如在北海和墨西哥湾的平台上部署自己的机器狗。

企业必须始终提前计划并尝试预测问题，尽管这存在很大的不确定性。此外，上市公司也有股东，通常包括一些环保人士，他们往往会问一些关于气候的烦人的问题。然后还有监管机构，它们试图确保企业去尝试处理大问题，以免责任最终落到政府头上。

结果是大公司至少正在谈论气候变化，考虑它如何影响运营并计划如何调整适应。

对一些公司来说，这种需要是明摆着的。英国最大的水务公司泰晤士水务

（Thames Water）运营的伦敦及其周边地区正在变得越来越热，而尽管总降雨量似乎尚稳定，但降雨变得更大更急，而干旱的间隔变得更长。这意味着泰晤士水务必须投资以同时应对更频繁发生的洪涝和干旱。

在干旱方面，该公司制定了通过安装仪表来堵漏和抑制需求的宏伟计划。它还将利用伦敦南部的含水层作为水库，在水量充足时充水，在旱季抽水，并利用现有的运河网络从塞文河（一条位于其服务区之外的大河）引水。它还计划开始重新利用其污水处理厂生产的一些水。

针对洪涝的主要解决方案是伦敦人口中的“超级下水道”，这是一条7米宽、24公里长的隧道，2024年完工后将由泰晤士水务管理。这条耗资49亿英镑（57亿美元）的管道从西向东横跨整个城市，当暴雨淹没了正常的下水道系统时，它将充当一个巨大的溢流口。（伦敦的污水管道兼作雨水渠，这是1860年代做出的设计选择，现在几乎不可能推翻重来。）该公司的所有污水处理厂和泵站都经过评估，以判断它们是否也有淹水风险。

为了确保一直到2100年都有充足的供水，泰晤士水务制定了一系列取决于气候变化、人口和经济的“适应途径”。其投资基于详尽的规划和预测，使用2020年代、2050年代和2080年代的低排放、中排放和高排放情景，并给出了多个置信度。尽管如此，即使对该公司来说，气候变化也不是其投资决策中最决定性的因素。在没有额外投资的情况下，到2045年，预计到的供水短缺有一半是因需求的变化造成，主要是由于人口增长。气候变化只占四分之一。

即使在受气候变化影响不太明显的行业，大企业也在认真对待适应问题。跨国消费品公司联合利华试图量化在三种不同监管情景和一系列不同温度升幅下，气候变化对其2030年、2039年和2050年业绩可能产生的影响。这显然对利润很重要。

| 给业主他们想要的

联合利华最新的年度报告同时讨论了这样的可能性：通过抓住对纯素食和素食食品日益增长的需求，到2050年将年利润提高64亿欧元；如果公司被

征收涵盖所有环节的排放的碳税，可能损失61亿欧元。情景预测也帮助它制定适应战略，既针对气候变化的直接影响，也针对它们加剧的系统性问题：更严格的农业监管、更高的能源价格、日益严重的水资源短缺和大宗商品价格上涨。

联合利华已经制定了在特定工厂遭到极端天气破坏时搬迁生产线的计划，也列出了供应链中断时的紧急供应商。它还在制定长期的应急计划，例如让洗发水更易冲洗干净，以防客户被迫节约用水。它的大部分洗碗机清洁剂都可在冷水中使用，为一个能源贵得多的世界做好准备。

如果维持利润的需要不足以激励公司适应气候变化，那么还存在外部压力。环保主义者往往主要关注减少排放，气候专家称之为“减缓措施”。但对于大多数投资者，或者至少是长期投资者来说，适应也很重要。泰晤士水务公司和联合利华都在年度报告中详细说明了它们正在采取的适应措施，部分原因是遵循了气候相关财务信息披露工作组（TCFD）的建议。

该工作组源自于金融稳定委员会（Financial Stability Board），这是一个国际机构，旨在通过更健全的监管来避免未来的金融危机。TCFD表示，总市值达27万亿美元的各类企业已经签署了其标准。包括英国和欧盟在内的八个司法管辖区的监管机构要求上市公司遵守其指导方针的不同部分。企业不喜欢提醒投资者注意其计划中潜在的缺陷，因此要求披露此类风险的法案会刺激它们做出适应措施。

较小的公司无法负担顾问费用来勾勒出未来气候变化的情景，并针对1.5°C、2°C和4°C的变化制定适应计划。未上市公司不会面临如此大的压力来做这件事，但其版图也往往不那么庞大，对未来可能会发生什么也有更清晰的认识。无论大小，无论是国营还是私营，企业一般都不懈地关注自己的生存。对于发展中国家的小企业（当然对于穷人来说也是如此），问题不在于缺乏适应的意愿，而在于缺乏资金。■



Common sense

The rich world is wrong to think that climate impacts in poor countries don't matter

There is a compelling moral case for rich countries to do more to help poor ones adapt

JEM BENDELL, a British academic, is an advocate of what he calls “deep adaptation”. The world, he believes, should prepare for “near-term societal collapse”. He urges not only “resilience”, climate-speak for equipping people to withstand climate change, but also “relinquishment”, by which he means abandoning “assets, behaviours and beliefs” that it will be futile to try to retain, such as living near the coast or expecting to maintain, or attain, a rich-world lifestyle. Politicians and the public are not taking this prescription seriously, he argues, not because it is excessive, but because they are not psychologically prepared to consider it.

The depth of the dislocations he talks about makes Mr Bendell unusual among advocates of adaptation. The fact that he stresses adaptation makes him unusual among those concerned about catastrophic climate change. It was once common for such people to be frank in their distrust of the whole idea of adaptation. They saw it as at best a distraction from the more important task of mitigation, and at worst an alternative to cutting emissions pushed by vested interests. Such suspicions are less common today, but they have not vanished completely. “You can't adapt your way out of climate change” is still a slogan with currency.

In one sense it is clearly true. Take low-lying atolls. Even with strenuous mitigation, some will be relinquished to the sea. The average elevation of the 1,100 islands which make up the Maldives is a mere 150 centimetres. Although reclamation is building up some of them, others are bound to disappear.

But in another sense, the submergence of much of the country does not mark the sort of “hard limit” to adaptation sceptics like to talk about. The people of the Maldives will not simply stand still as the water rises above their waists; they will resort to ever more radical forms of adaptation, presumably culminating, if need be, in mass emigration. Last year the World Bank concluded that by 2050, without more mitigation and adaptation, 216m people would be displaced within their own countries by climate change, 86m in sub-Saharan Africa alone. Most of these will not travel far from home. Some will, either through aspiration, local hostility or, in the case of island states, necessity. An ageing rich world may need such fluxes. It currently looks unlikely to welcome them.

Viewed from this perspective, mitigation and adaptation are not in competition with one another; they go hand in hand, pat as that may sound. Patrick Verkooijen, the head of the Global Centre on Adaptation, says that the more mitigation there is, the easier his job becomes, as less adaptation will be needed. What is more, in poor countries both adaptation and mitigation are in essence different forms of development work, and should be co-ordinated as such. Building a green power supply or low-emission transport network, for example, might be done in a way that draws people away from vulnerable jobs or places. Adaptation averts the losses and disruption faced by government, businesses and households when the power goes out or the road is washed away. The benefits only increase as climate change intensifies.

Those in the rich world who consider all this worthy but less than urgent should remember that the benefits of investing in adaptation are not limited to the places where the spending occurs. One of the fundamentals of climate science is that causes and effects can be widely separated. Sea temperatures in the eastern Pacific are linked to hurricane frequencies in the Caribbean; tropical volcanic eruptions can warm the poles. The world’s economy and its geopolitics are stuffed with similar “teleconnections”.

Most analyses of future climate calamities in the developing world focus on local impacts. In practice less adaptation and more suffering in poor countries will inevitably have consequences in wealthier places. At the very least the proliferation of flooded slums and parched fields would increase the pressure on wealthy governments to spend more on disaster relief, a vastly less productive investment than adaptation to forestall disasters. But in all likelihood, the consequences for the rich world would be much more severe. The prices of staple foods may shoot up. Supply-chains would suffer multiple ruptures. Then there is the spectre of those unwanted climate refugees.

But there is also a compelling moral case for rich countries to do more to help poor ones adapt. The people who are suffering the most as a result of climate change are the ones who have done the least to cause it. It takes money both to generate industrial emissions and to adapt to their consequences. Poor countries are not doing much of either. To leave them to suffer because of the mess created by the rich world and middle-income countries is akin to asking the people of Haiti, Niger and Nepal to pay to decarbonise America's and Europe's power supply.

To put things in Mr Bendell's terms, to relinquish something by choice may be an act of clear-eyed humility; to be deprived of it as the result of what others have done is more akin to being robbed. Leaders of developing countries are right to fulminate against the world's selfishness. It is not just climate change that is a problem for everyone; so is dealing with the damage that it does. ■



常识

富国错误地认为穷国的气候影响无关紧要

它们确实有道德上的义务来更多帮助穷国适应变化【专题《时代的挑战》系列之二】

英国学者杰姆·本德尔（Jem Bendell）积极倡导他提出的“深度适应”。他认为，世界应该为“近期的社会崩溃”做好准备。他不仅敦促建立“韧性”——在气候议题相关语汇中指让人们准备好抵御气候变化，而且还敦促“放弃”，意思是放弃努力维持“资产、行为和信仰”的无谓尝试，例如仍想在沿海生活，或期望维持或拥有富裕世界的生活方式。他认为，政客和公众并没有认真对待这个药方，并不是因为它太过度，而是因为他们还没有做好心理准备来考虑这个方案。

本德尔谈论的混乱程度之深，让他在倡导适应的人群中显得与众不同。他强调适应这一点也使他在担忧灾难性气候变化的人中显得格格不入。这些人曾一度坦率地说他们对“适应”这个想法完全不信任。他们认为这充其量只是分散了对更重要的“减缓”任务的注意力，最坏的情况则是既得利益者在推动减少排放的替代方案。这种怀疑在今天已经不那么常见了，但并没有完全消失。“你无法适应气候变化”仍然是一个流行的口号。

在某种意义上，这显然是正确的。以低洼的环礁为例。即使采取了顽强的减缓措施，一些环礁依然会被大海淹没。构成马尔代夫的1100个岛屿的平均海拔仅为150厘米。尽管填海造地正在把其中的一些增高，但其他一些必然会消失。

但从另一个意义上说，该国大部分地区的淹没并不标志着质疑适应措施的人喜欢谈论的那种“硬性限制”。马尔代夫人不会眼睁睁地看着水面没过腰。他们将诉诸于越来越激进的适应形式，如果需要，可以想见会以大规模移民为顶点。去年，世界银行得出结论，如果没有更多的减缓和适应措施，到2050年将有2.16亿人因气候变化在本国内部重新安置居所，仅撒哈拉以南非洲就会有8600万人。其中大部分会搬到离家乡不远的地方。有些人会远走他乡，要么出于愿望，要么因为本地的敌意，要么（对于岛国而

言)是出于必需。老龄化的富裕世界可能需要这样的人口流入。它目前看来似乎不太可能欢迎这些人。

从这个角度看,减缓和适应不是相互竞争的;二者齐头并进,相辅相成。全球适应中心(Global Centre on Adaptation)负责人帕特里克·维尔科伊恩(Patrick Verkooijen)表示,减缓措施越多,他的工作就越轻松,因为需要的适应就越少。更重要的是,在贫困国家,适应和减缓本质上是不同形式的发展任务,也应该依此来协调。例如,绿色电力供应或低排放交通网络的打造方式或许能让人们远离易受气候影响的工作或地方。适应措施可以避免政府、企业和家庭在停电或道路被冲毁时面临的损失和破坏。随着气候变化的加剧,好处只会增加。

那些认为所有这些都值得但没那么紧迫的富裕国家的人应该记住,投资于适应的好处不仅限于发生支出的地方。气候科学的基本原理之一是原因和影响可以相距很远。东太平洋的海水温度与加勒比地区的飓风频率有关;热带火山喷发会使两极变暖。世界经济及其地缘政治充斥着类似的“遥相关”。

大多数对发展中国家未来气候灾难的分析都集中在对本地的影响上。在实践中,贫穷国家的适应能力越差,遭受的痛苦越多,将不可避免地富裕地区产生影响。至少,洪水泛滥的贫民窟和干裂的土地激增会增加富裕政府在救灾上投入更多资金的压力,这种投资的效率相比投资于适应以预防灾害要低得多。但富裕世界承受的后果多半要比这严重得多。主食价格可能会上涨。供应链将遭受多次断裂。然后还有不受欢迎的气候难民涌入的隐忧。

但还有一个令人信服的道德理由来要求富国采取更多措施帮助穷国适应。因气候变化而受害最深的人是造成气候变化最少的人。产生工业排放和适应其后果都需要钱。穷国在这两方面都没有做太多。让他们因为富裕世界和中等收入国家造成的灾难而受苦,无异于要求海地、尼日尔和尼泊尔人民为美国和欧洲的供电脱碳出钱。

用本德尔的话说，主动选择放弃某些东西可能是一种清醒的谦逊行为；因为别人的所作所为而被剥夺了它则更像是被抢劫了。发展中国家的领导人
有理由怒斥世界的自私。不单气候变化是每个人都面临的问题；处理它造成的
损害也是如此。 ■



Renewable energy

India's next green revolution

India's clean-energy push shows a way to escape the coal addiction

IF YOU CARE about the climate a crucial question is how emerging economies, which accounted for 67% of carbon-dioxide emissions from energy last year, can shift to a cleaner approach. They derive a third of their primary energy from coal, and must meet the aspirations of poor citizens who lack cheap electricity.

China offers one template: its energy industry is shifting towards renewables. Yet it is still moving far too slowly to reduce its emissions and many countries may be wary of replicating its state-led approach. An alternative model is now visible in the other Asian giant, India, which is in the early stages of a green boom led by the private sector. Although it has obvious flaws, it provides hope that India can make the green leap.

India has immense energy needs. It is forecast to be one of the fastest-growing big economies this decade and will need to add capacity equivalent to the size of the European Union's power system by 2040. After a flirtation with hydro in the 1950s and 1960s it came to rely heavily on coal, which met 58% of its primary-energy needs in 2021. Like many governments, India's has committed to reaching net-zero emissions (by 2070).

The big surprise is that major changes are happening on the ground. In the past decade India has seen a 50-fold increase in installed solar power. In 2021 its renewables accounted for 5% of its primary-energy consumption, and 5% of global renewable primary-energy consumption. Private firms have plans to invest perhaps \$200bn in the coming years in everything from generation facilities to green hydrogen plants (by comparison, global

investment in wind and solar last year was about \$300bn, and India's was roughly \$15bn). The government wants to triple non-fossil-fuel capacity by 2030.

Behind the boom are a number of forces. One is the country's underlying attributes: sun-drenched India has some of the cheapest solar power in the world, and the life-cycle cost of new plants is lower than for coal ones. The government has helped by introducing guarantee mechanisms so that firms forced to deal with rickety power distributors can still secure funding. The prime minister, Narendra Modi, views clean energy as a catalyst for an industrial boom based on cheap power, batteries and electric vehicles that may shift manufacturing supply chains away from China. Clean power will help cut a large import bill for fossil fuels and, by lowering pollution, save millions of lives.

The final force is that India's big local conglomerates (including Reliance Industries, Adani Group and Tata Group) are deploying capital at scale. Whereas previously they would have been wary of such investments, now they think they have the certainty, financial clout and expertise to plough ahead. One gauge of the boom is that some investors and firms are getting more nervous about long-run coal projects, as cheap renewable power starts to undercut coal-fired power on price. Between 2010 and 2022, proposals for over 600GW of coal-fired power in India (about three times its installed base of coal plants) have either been put on hold or scrapped, with another 15GW-worth of coal generation retired from service.

Yet for all its successes India's surge faces several hurdles. One is financing. Experts reckon it will take over \$500bn of investment by 2030 in clean energy, transmission lines, grid-scale batteries and related kit to achieve the government's 500GW. That is at least twice the present investment plans of the big firms, so India will have to attract new sources of capital at a time when interest rates are rising. The financial strain of huge capital

projects could yet weaken the appetite of the big conglomerates: Adani Group, for example, is significantly indebted.

| *Power struggle*

The biggest hurdle of all relates to government policy, which needs to be predictable enough to provide certainty to investors. It also needs to anticipate challenges—redesigning electricity grids, for example, as the share of intermittent power rises. India’s officials have a good sense of what to do. But they face resistance from a coal lobby which controls vast budgets and employs millions. A state-run firm, NTPC, has just gone ahead with its first new coal plant for about six years; a government advisory body has called for more coal capacity. India’s green boom is a test of the private sector’s ability to marshal resources—and also of the government’s ability to overcome vested interests. ■



【首文】可再生能源

印度的下一场绿色革命

印度推进清洁能源的行动展示了一条摆脱煤炭依赖的道路

如果你关心气候，有个问题很关键，就是新兴经济体怎样才能转向更清洁的能源获取方式。去年，它们为生产能源造成了67%的二氧化碳排放量。它们有三分之一的一次能源来自煤炭，还必须满足缺乏廉价电力的贫困民众的渴望。

中国提供了一个模板：其能源产业正在向可再生能源转型。但它在减排方面的动作仍然太慢，而许多国家对于照搬它的国家主导的模式可能也会态度谨慎。在另一个亚洲巨人印度，一种替代模式已经显现。该国正处于一场由私营部门引领的绿色繁荣的早期阶段。尽管这种模式有明显的缺陷，但它让人看到了希望，认为印度也许能实现绿色飞跃。

印度有着巨大的能源需求。据预测，它将成为这个十年增长最快的大型经济体之一，到2040年它需要增加的装机容量相当于整个欧盟电力系统的规模。在上世纪五六十年代短暂尝试了水电后，它开始严重依赖煤炭。2021年，煤炭满足了它58%的一次能源需求。像许多政府一样，印度政府也承诺实现净零排放（到2070年）。

令人大为惊喜的是，重大的变化正在实地发生。在过去的十年里，印度的太阳能装机容量增长了50倍。2021年，它的可再生能源占到本国一次能源消费的5%，占全球可再生一次能源消费的5%。私营企业计划在未来几年投资大概2000亿美元，支持从发电设施到环保制氢工厂的各种项目（相比之下，去年全球风能和太阳能投资约为3000亿美元，印度约为150亿美元）。印度政府希望到2030年将非化石燃料产能增加两倍。

这股繁荣背后有多种力量在推动。一个是该国的基本特性：阳光充足的印度拥有一些世界上最便宜的太阳能，新电厂的生命周期成本也低于燃煤电厂。政府通过引入保障机制来提供帮助，让那些不得不与不牢靠的电力分

销商打交道的企业也能获得资金。印度总理莫迪将清洁能源视为一种催化剂，能推动一场基于廉价电力、电池和电动汽车的工业繁荣，也许会将制造业供应链从中国转移出去。清洁能源将有助于削减化石燃料的巨额进口费用，并通过降低污染拯救成百上千万人的生命。

最后一股力量是包括信实工业、阿达尼集团和塔塔集团在内的印度本土大型企业集团正在大规模部署资本。它们以前对这类投资很警惕，但现在它们认为已经有把握也有财力和专业知识来推进这一块。衡量这场繁荣的一个尺度是一些投资者和公司长期对煤炭项目越发担忧，因为廉价的可再生能源开始在价格上碾压煤电。2010年至2022年间，印度有超过600吉瓦的燃煤发电项目提案（约为其现有燃煤电厂装机容量的三倍）要么被搁置，要么被取消，另有15吉瓦的燃煤发电机组退役。

然而，尽管取得了多种成果，印度的能源崛起仍面临一些障碍。其一是融资。专家估计，要实现政府的500吉瓦的目标，到2030年将需要在清洁能源、输电线路、电网规模的电池和相关配套设施投资超过5000亿美元。这是大公司目前投资计划的至少两倍，因此印度将不得不在利率上升之时吸引新的资金来源。超大型资本项目带来的财务压力可能会削弱大型企业集团的胃口，比如阿达尼集团就负债累累。

| 电力斗争

最大的障碍与政府政策有关。政府政策需要有足够的可预测性，让投资者心里有数。还要能预见挑战——例如，随着间歇性发电的份额上升，需要重新设计电网。印度官员很清楚该做什么。但是他们面对来自煤炭游说团体的阻力，它们控制着庞大的预算，雇用了数百万人。国营公司印度国家火电公司（NTPC）刚刚开始建造它差不多六年来的第一座新煤电厂；一家政府咨询机构呼吁增加煤炭产能。印度的绿色繁荣考验私营部门调动资源的能力，也考验政府克服既得利益阻力的能力。■



A virtuous circle

Battery-makers are powering a circular economy

“Gigafactories” are being designed to recycle raw materials

MANUFACTURING IS A one-way business. Raw materials go into a factory and finished products come out. Once those goods are sold, producers (initial guarantees apart) usually wash their hands of them. Certainly they do not worry, unless compelled to by law, about how the products are disposed of. Most are burnt or rot in landfill, which pollutes the planet. In only 50 years the world’s consumption of raw materials has nearly quadrupled, to more than 100bn tonnes, according to the latest Circularity Gap Report from the World Economic Forum. Less than 9% of this is reused, resulting in a big waste of materials.

Industry does talk about sustainability and recycling, but much of that is greenwashing intended to improve brand images. Yet in the circular economy the bottom line, too, can benefit from greenery. This is especially so in the case of “gigafactories”, so called because their output of batteries for electric vehicles (EVs) is measured in gigawatt hours (GWh).

Every carmaking country wants gigafactories. Batteries are the costliest part of an EV, so making them is lucrative. But they contain materials such as lithium, cobalt, manganese and nickel that are pricey and can be hard to obtain. Supply chains are long and complicated. Buyers risk being tarnished by their suppliers’ (or suppliers’ suppliers’) poor environmental and labour standards. Reusing materials makes sense.

Being new, most gigafactories are designed with recycling in mind from the start. The result is a circular production process, not a linear one. The idea is that once batteries reach the ends of their lives, they should go back to a factory, where their ingredients can be recovered and put into new

batteries.

Gigafactories are not yet exemplars of the circular economy, but they are laying the foundations. Northvolt, a Swedish battery-maker, aims by 2030 to produce 150GWh of batteries—enough to power some 2m EVs—from the three gigafactories it is completing. By then, around half its raw materials should come from recycling old batteries. Northvolt is not alone. Using recycling, renewable power and other measures, CATL—a Chinese firm and the world's biggest producer of EV batteries—thinks it should eventually be possible to shrink the carbon footprint of a battery towards zero.

Carmakers such as the Renault Group and Stellantis, owner of brands that include Fiat, Chrysler and Peugeot (and whose big shareholder, Exor, also owns a stake in The Economist's parent company), are both setting up circular-economy businesses. This is not just for batteries, but also for repairing and reconditioning parts and vehicles. Each of these operations will, bosses hope, have annual revenues of more than €2bn (\$2bn) by the end of the decade, and be profitable. Renault reckons around 85% of a car is recyclable, but only 20-30% of the materials in new vehicles are recycled, often from other goods. Circular manufacturing would greatly increase that share.

Could other industries do something similar? Fast fashion is a notoriously wasteful business in which little-worn clothes are burnt or dumped. America's Environmental Protection Agency estimates that the recycling rate for clothing and footwear is just 13%. A big part of the reason is the use of mixed textiles, which are hard to recycle. Clothing companies could, like gigafactories, re-engineer their processes to employ fibres that are easier to handle. Consumer electronics is another business that creates heaps of waste, despite electronic circuits containing precious materials such as gold and silver, and electric motors being made from rare-earth metals like neodymium and dysprosium. Fortunes could yet be made in the urban

mining of last year's gadgets and yesterday's togs. ■



【首文】良性循环

电池制造商正在驱动循环经济

“超级工厂”的设计将回收利用原材料

制造业是门单向的生意。原材料进厂，成品出厂。一旦商品售出，生产商（提供初始质保的除外）通常就撒手不管了。它们自然也不担心产品在废弃后是如何被处理掉的，除非有法律强制它们过问这件事。大多数产品最后都被焚烧或在垃圾填埋场里烂掉，污染地球。世界经济论坛（World Economic Forum）发布的最新《循环缺口报告》（Circularity Gap Report）显示，在短短50年间，全球原材料消费增长了近三倍，达到逾1000亿吨。其中只有不到9%被重复利用，这造成了巨大的材料浪费。

工业界确实在谈论可持续性和回收利用，但大部分实则是漂绿，为的是改善品牌形象。但是，如果投身循环经济，企业的盈利状况也可以从环保举措中获益。“超级工厂”尤其如此。之所以叫这个名字，是因为它们的电动汽车电池产出是以吉瓦时（GWh）的规模来衡量的。

每个汽车制造国都想要超级工厂。电池是电动汽车中最昂贵的部分，所以制造电池利润丰厚。但它们含有的锂、钴、锰和镍等材料昂贵且难以获得，电池供应链也又长又复杂。买家的名声还有被供应商（或供应商的供应商）糟糕的环境和劳工标准连累的风险。重复使用材料是明智之举。

作为一种新型工厂，大多数超级工厂从设计之初就考虑到了回收利用。由此形成了一个循环的生产流程，而不是线性的。其理念是一旦电池到了使用寿命的尽头，就应该送回工厂，在那里它们的成分可以被回收并用于新电池。

超级工厂还不是循环经济的典范，但它们正在奠定基础。瑞典电池制造商Northvolt定下目标，要到2030年从它正在建设的三个超级工厂中生产150吉瓦时的电池，足以为大约200万辆电动汽车提供动力。到那时，它应该会有大约一半的原材料来自回收旧电池。Northvolt并不是孤例。世界上最

大的电动车电池生产商中国公司宁德时代认为，通过回收利用、使用可再生能源和其他措施，它最终应该能将电池的碳足迹减少到零。

汽车制造商如雷诺集团和拥有菲亚特、克莱斯勒和标致等品牌的斯特兰蒂斯（Stellantis，其大股东Exor也持有本刊母公司的股份）都在建立循环经济业务，不仅涉及电池，还有零部件和车辆的维修和翻新。老板们希望，到2030年前，每项业务的年收入都将超过20亿欧元（20亿美元），并实现盈利。雷诺估计一辆汽车有85%的部分可以回收，但目前一辆新车只有20%到30%的部分使用了回收材料，通常来自其他物品。循环制造将大幅增加这一比例。

其他行业是否可能做类似的事情？快时尚业出了名地浪费，会把没怎么穿过的衣服烧掉或扔掉。美国环境保护署估计服装和鞋类的回收率只有13%。很大一部分原因是它们使用的是混合纺织品，难以回收。服装公司或许可以像超级工厂那样重新设计生产流程，改用更容易处理的纤维。另一个产生大量废弃物的行业是消费电子产品，尽管电子电路含有金银等贵重材料，而电动马达由钕和镝等稀土金属制成。在城市里淘一淘过时的小型电子设备和旧衣服仍有可能大赚一笔。 ■



Conglomeritis spreads

What big tech and buy-out barons have in common with GE

Unaccountable bosses, declining returns on capital and fed-up investors

CONGLOMERATES COULD hardly be less fashionable. The diversified industrial empires of old are taught as case-studies in underperformance, misaligned management incentives and poor capital allocation. Bosses fear that a “conglomerate discount”—the difference between the market value of a firm and the hypothetical value of its constituent parts—will invite activist investors to agitate for divestments. Focus is now the *idée fixe* of industrial organisation.

Few were surprised when General Electric (GE), a poster-child for expansion-induced destruction of shareholder wealth, announced plans to break in three in November 2021. This unravelling, which is likely to be completed in 2024, is far from novel. Johnson & Johnson, 3M and Kellogg are all in the middle of breaking up. Germany’s Thyssenkrupp and Siemens have both recently completed hulking divestitures. Toshiba, a Japanese industrial giant, narrowly avoided a breakup earlier this year. The conglomerate has proved more resilient in the developing world. But even there some empires are under attack. In China, for example, Fosun, an acquisitive globetrotting group, is hawking off assets in order to tackle its crippling debt pile.

Even as some old strains of conglomeritis are in remission, however, new ones have emerged. Public and private markets have put their faith—and capital—in sprawling empires built around the twin engines that have propelled the modern economy over the past few decades: digital technology and cheap debt. A fifth of the market value of the S&P 500 index of big American firms sits in five giant technology companies—Alphabet, Amazon, Apple, Meta and Microsoft—which have spent a part of their

profits chasing diversification (see chart 1). Simultaneously, low interest rates and an explosion in the assets managed by private-equity firms such as Apollo, Blackstone and KKR have created vast and diversified investment portfolios of controlling interests in firms: buy-out barons spent more than \$1.1trn globally in 2021 alone.

Tech CEOs bristle at any mention of the c-word. Their diversification is fuelled by the logic and profitability of the digital economy, they insist, not by the desire to manage a balanced portfolio of distinct subsidiaries as in old-school conglomerates. Engineering clout and access to data provide economies of scale and scope in product development; demand-side synergies emerge from bundling and “digital ecosystems”. Bosses at ITT, once among the largest diversified American conglomerates, encouraged employees and suppliers to rent cars from Avis, one of its divisions. The links between products at big-tech firms are far stronger: Apple’s watches and earphones, as well as its TV series and playlists, are part of the iPhone ecosystem; shopping for kale and kombucha at Whole Foods is cheaper if you join Prime, Amazon’s membership programme.

Look closer, though, and similarities abound. Huge profits from tech firms’ core businesses have funded a giant land-grab. Amazon’s dominant position in cloud computing, initially intended to support its e-commerce marketplace, now contributes the lion’s share of profits and bankrolls big bets in entertainment (like the \$8.5bn acquisition of MGM, owner of the James Bond franchise), health (a \$3.9bn deal to buy One Medical, a provider of primary care) and space (Amazon plans to invest more than \$10bn in its Kuiper satellites). Alphabet’s lucrative search-ad and YouTube businesses subsidise a loss-making cloud operation and a moonshot unit, which together lost more than \$2bn in the most recent quarter. The result is that big tech firms now compete across multiple industries, largely with each other.

Private-equity firms, too, have come to resemble the sprawling groups they once dismantled. Low interest rates created alternative-investment behemoths managing trillions of dollars in privately held equity, credit, property and infrastructure assets. Attempts to raise sources of permanent capital invite comparisons to Berkshire Hathaway, Warren Buffett's \$640bn diversified holding company. The financial groups' buy-out arms are vast pools of capital invested across multiple sectors: the portfolio companies of Apollo employ more than twice as many workers as GE.

Now the magic is fading for the new conglomerates. It is financial engineering, not operating know-how, which has juiced private-equity returns. According to a study by Bain, a consultancy, expanding margins accounted for only 6% of private-equity value-creation during the past five years. Leveraged buy-outs struck at high valuations will hurt returns for some big funds. In the absence of cheap money, dealmakers will either sit on their piles of dry-powder or try their luck as judicious conglomerate-managers capable of striking bargains and nurturing businesses. Most will struggle with this transition.

The true extent of private-equity firms' problems may remain cloudy for a while. But the reckoning will come, because their funds are by design time-limited. Eventually, the funds' managers will be forced to sell the assets and return cash to investors. Underperformers will find themselves unable to raise new funds.

Big-tech bosses face no such automatic disciplining mechanism. So long as the companies' core businesses printed money, investors humoured their side hustles and tolerated declining returns on capital at some firms. In aggregate for the big five this has fallen by more than half over the past five years (see chart 2).

As tech firms' profit engines come under pressure—advertising and cloud-

computing profits are facing cyclical headwinds and increased competition—investors are questioning the logic of the firms’ portfolios, says Emilie Feldman of the Wharton School of the University of Pennsylvania. The shares of Alphabet, Amazon and Meta have all lost more than 10% of their value since the companies’ latest quarterly reports in late October. Mark Zuckerberg, founder and chief executive of Meta, got an earful from investors about money-losing moonshots and bloated, costly workforces. His opposite numbers at Alphabet and Amazon, Sundar Pichai and Andy Jassy, could face similar treatment soon enough.

As hired guns, Messrs Pichai and Jassy wield little formal power over their boards. That may yet make them receptive to calls for greater focus. Mr Zuckerberg, who lords it over Meta thanks to dual-class shares, seems deaf to investors’ wails. He wants to keep spending perhaps \$15bn a year to expand his digital domain to the metaverse. As symptoms of conglomeritis go, none is more classic than an unaccountable boss with empire-building ambitions. ■



大公司病蔓延

科技巨头和收购大王与GE有什么共同点

不受问责的老板、不断下降的资本回报和忍无可忍的投资者

人们对企业集团的嫌弃已经无以复加了。过去的多元化工业帝国如今成了业绩不佳、管理激励错位和资本配置差劲的教学案例。老板们担心“集团价值折让”（即一家公司的市场价值小于其各部分业务加在一起的假定价值）会让激进投资者鼓动分拆。如今，聚焦成了工业企业的执念。

GE是扩张导致股东财富损失的典型代表，它在2021年11月宣布计划一分为三时，几乎没有人感到意外。这场应该会在2024年完成的分拆绝不是什么新鲜事。强生、3M和家乐氏都在分拆中。德国的蒂森克虏伯（Thyssenkrupp）和西门子最近都完成了大规模的资产剥离。日本工业巨头东芝在今年早些时候也差点分拆。事实证明，发展中国家的企业集团更具韧性。但即使在那里，也有一些企业集团备受指摘。例如在中国，收购足迹遍布全球的复星集团正为解决严重的债务问题兜售资产。

然而，在大公司病的一些旧病株缓解的同时，新的病株又已出现。过去几十年里，数字科技和低廉信贷推动了现代经济的发展，公开市场和私有市场把信心和资本都集中投放到围绕这两个引擎不断扩张的企业帝国之上。在代表美国大公司的标准普尔500指数市值中，亚马逊、苹果、Meta和微软这五家大型科技公司占了五分之一，它们都将部分利润用于追求多元化（见图表1）。同时，低利率加上阿波罗（Apollo）、黑石（Blackstone）和KKR等私募股权公司所管理资产的爆炸式增长创造了庞大且多元化的公司股权投资组合，仅2021年，收购巨头就在全球花了超过了1.1万亿美元。

科技公司的CEO听到大公司病这个词就恼火。他们坚持认为，自己的多元化是由数字经济的逻辑和盈利能力推动的，而不是像老派的企业集团那样渴望管理一个由各种毫不相干的子公司构成的平衡组合。工程实力和获得数据的能力让产品开发得以实现规模经济和范围经济；捆绑销售和“数字生态系统”产生了需求侧协同效应。ITT曾经是美国最大的多元化企业集团

之一，其老板鼓励员工和供应商从下属公司安飞士（Avis）那里租车。大型科技公司的产品之间的联系更是紧密得多，苹果的手表和耳机及它的电视剧和歌单都是iPhone生态系统的一部分。如果你成为亚马逊的Prime会员，在全食超市（Whole Foods）买羽衣甘蓝和康普茶会更便宜。

然而，仔细观察就会发现，新旧两派之间有许多相似之处。科技公司的核心业务赚到的巨额利润为大规模攻城略地提供了资金。亚马逊的云计算业务原本只是为了支持它的电商平台，如今已占据行业主导地位，贡献了最多的利润，并提供资金让公司大笔下注娱乐业（例如以85亿美元收购拥有007系列电影的米高梅）、医疗保健业（以39亿美元买下基础医疗供应商One Medical）和航天业（亚马逊计划在其Kuiper卫星上投资超过100亿美元）。Alphabet利润丰厚的搜索广告和YouTube业务一直在补贴其亏损的云业务和“登月”部门，这两个部门在最近一个季度共亏损超过20亿美元。结果是大型科技公司现在在多个行业参与竞争，而且主要是相互竞争。

私募股权公司也开始变得像那些它们过去分拆掉的那些庞大集团。低利率造就了另类投资巨头，它们管理着万亿美元计的私人股权、信贷、房地产和基础设施。增加永久资本来源的尝试让人联想到沃伦·巴菲特那市值6400亿美元的多元化控股公司伯克希尔·哈撒韦（Berkshire Hathaway）。这些金融集团的收购部门拥有大量资本，投资多个行业。阿波罗投资的公司雇用的员工人数是GE的两倍多。

现在，这些新金融集团的魔力正在消退。提高了私募股权回报的是金融工程，而不是运营专长。根据咨询公司贝恩的一项研究，在过去五年中，不断提高的利润率仅占私募股权价值创造的6%。在高估值下完成的杠杆收购将损害一些大型基金的回报。在没有了廉价资金的情况下，交易商们要么守着自己的“干火药”观望，要么拿出能达成交易和培育业务的精明的大集团管理者的样子来试试运气。大多数集团都会难以适应这种转变。

私募股权公司问题到底严重到什么程度可能一时仍不明朗。但清算终会到来，因为它们管理的基金本身是有期限的。最终，基金管理公司将不得不出售资产，向投资者返还现金。表现不佳的公司将无法再筹到新资金。

大型科技公司的老板们没有这种自动的约束机制。只要这些公司的核心业务还能大把赚钱，投资者就会迁就它们搞搞副业，并容忍一些公司的资本回报率下降。总体而言，在过去五年中五巨头的资本回报率下降了一半以上（见图表2）。

宾夕法尼亚大学沃顿商学院的艾米丽·费尔德曼（Emilie Feldman）表示，由于科技公司的利润引擎面临压力——广告和云计算利润面临周期性逆风和竞争加剧，投资者正在质疑这些公司的投资组合的逻辑。自10月底发布最新季报以来，Alphabet、亚马逊和Meta的股价均下跌了10%以上。Meta的创始人兼首席执行官扎克伯格由于“登月”项目亏损、人员冗余且薪酬成本过高的问题饱受投资者批评。Alphabet和亚马逊各自的老板桑达尔·皮查伊（Sundar Pichai）和安迪·贾西（Andy Jassy）可能很快就会遭受类似的待遇。

皮查伊和贾西是职业经理人，无法凌驾于董事会之上。这可能会让他们更容易接受要求公司更加聚焦的呼声。扎克伯格凭借双重股权结构在Meta大权在握，似乎对投资者的疾呼充耳不闻。他希望继续每年花大约150亿美元将他的数字领地拓展到元宇宙。说到大公司病的症状，最经典的莫过于有一位怀有开疆拓土的野心但又不会被问责的老板了。■



Bartleby

How to think about gamification

The world of badges, streaks and leaderboards

THE MOPEI phone-swing device is ingeniously depressing. It is a cradle for smartphones that rocks back and forth when it is plugged in, and it is designed to cheat fitness apps into believing that you are on the move. If you have a step counter, this phone shaker can gull it into thinking you have taken 8,700 paces in an hour. “Ideal for those people who don’t have the time or energy to get your recommended steps in,” boasts the product blurb.

Such cheating is pointless but not uncommon. Blog posts run through ways to trick a Fitbit into recording exercise, from strapping it to your children to swinging it on a piece of string. Strava is an app for runners and cyclists to record their times; becoming the fastest rider on a course segment is a lot easier if you use a motorbike. Players of Pokemon Go, a smartphone game, are supposed to walk a certain distance in order to hatch virtual eggs; taping your phone to a Roomba, an automated vacuum cleaner, is the couch potato’s alternative.

This behaviour is a predictable side-effect of a ubiquitous digital phenomenon: gamification. Adding game-like elements to non-game activities is part and parcel of app design. Streaks encourage users to log into products each day. Achievement points reward them for completing tasks. League tables add the spice of competition.

Such features are powerful, even if their effects often fade over time. Just as gamification can lead some people to cheat, it can help others stay motivated in pursuit of a goal they find difficult to stick to. When Duolingo, a language-learning app, went public in 2021, its prospectus was clear about

the importance of game-like features in keeping its users engaged. Streaks, virtual currencies, leaderboards and a hectoring cartoon owl called Duo are all designed to encourage people to keep learning. On October 26th the firm launched a new mathematics app that relies on similar techniques.

But as “You’ve Been Played”, a thought-provoking new book by Adrian Hon, a game designer, makes clear, firms should be very careful about how they gamify experiences. Mr Hon argues against slapping the generic paraphernalia of rewards, points and badges onto activities without thinking hard about the context. Get gamification wrong, and you can annoy three types of stakeholder.

One is the customer. The obvious dangers—badgering people with endless notifications about streaks, say, or demotivating them by showing how low down a leaderboard they sit—are not the only ones. Gamification can work with the grain of a product, or against it. Apps that are designed to encourage people to save money can happily use gamified features like totalisers and money jars to track progress: the technique fits the product snugly. But some activities really don’t need added “fun”. One reading app offers to unlock animations if users hit certain reading landmarks; if you present reading as a chore, a kind of mental flossing, you are telling readers they have the cultural hinterland of a tapir.

The second stakeholder, and a new one to worry about, is the regulator. Gamification is meant to encourage people to do more of something. If that something is learning Japanese, great. If that something is eating lard, less great. Worries about how gamified financial-trading apps might lead investors to undertake more transactions than is good for them have prompted the Securities and Exchange Commission (SEC), a markets regulator, to look at what it terms “digital engagement practices”. Firms are already changing their behaviour as scrutiny intensifies. Last year Robinhood, one of the apps now in the SEC’s sights, felt compelled to get

rid of a confetti animation which showed when a customer made their first trade.

The third group is employees. Turning repetitive work into video games is a technique that Amazon has reportedly used in its warehouses, by representing workers' progress at picking and boxing items in a racing-car format. Firms that sell employee-engagement software offer the usual armoury of points, leaderboards and virtual currencies.

These ideas are likely to backfire. Forced rankings incentivise some people and stress others out. GitHub, an open-source coding platform, withdrew its streak feature after concerns were raised that it was prompting programmers to work every weekend. And as Mr Hon observes, games are a lot less enjoyable if you have no choice over whether to take part. Manufacturing fun can work, but only if it is taken seriously. ■



巴托比

如何看待游戏化

徽章、打卡和排行榜的世界【《你被耍了》书评】

MoPei手机摇步器是个令人唏嘘的小聪明。这个智能手机托架在插上手机后会前后摇晃，让健身应用误以为你在运动。如果你有个计步器，这个摇步器可以骗过它，让它以为你一小时走了8700步。“最适合那些没有时间和精力完成推荐步数的人。”产品推介中夸耀道。

这种作弊毫无意义，但并不少见。博主们都在发文传授如何骗Fitbit开始记入运动量——把它绑在孩子身上，或者系根绳子甩圈。Strava是一款记录跑步和骑车的应用。如果你骑上的是摩托车，要成为某个赛道最快的骑手就轻松了许多。手机游戏《精灵宝可梦Go》的玩家原本需要步行一定距离才能孵化虚拟蛋，但懒人们也可以把手机粘在Roomba扫地机器人身上让它代劳。

如今一股数字潮流无孔不入，这些行为是其可以想见的副作用。这股潮流就是游戏化。在非游戏活动中添加游戏类元素已经是应用设计中不可或缺的一环。每日打卡鼓励用户每天都登录产品。成就积分激励他们完成任务。排名表增添了竞争的趣味。

这些功能的效果往往会随着时间的推移而减弱，但它们的威力依然不可小觑。正如游戏化可能导致一些人作弊一样，它也可以帮助另一些人保持动力去追求他们感到难以坚持的目标。当语言学习应用多邻国（Duolingo）在2021年上市时，其招股书明确指出了游戏类功能在保持用户粘性方面的重要性。每日打卡、虚拟货币、排行榜和神气十足的卡通猫头鹰多儿（Duo）都是为了鼓励人们坚持学习。10月26日，该公司发布了一款新的数学应用，同样依赖类似的手段。

但正如游戏设计师阿德里安·韩（Adrian Hon）发人深省的新书《你被耍了》（You've Been Played）明确指出的那样，公司在提供游戏化体验时应

该慎之又慎。韩认为，不应该在没有认真考虑具体情境的情况下将奖励、积分和徽章等套路照搬到各种活动之上。游戏化如果没做好，可能会惹恼三类利益相关者。

首先是客户。一些弊端显而易见，例如不停地向人们发送打卡通知，或者展示他们在排行榜上的糟糕名次，让他们灰心丧气。但还不止于此。游戏化可能适合某种产品，也可能完全不适合。鼓励人们省钱的应用大可使用求和器和存钱罐等游戏化功能来跟踪进展——所用的方法完美契合了产品。但有些活动真的不需要添加额外的“乐趣”。有一款阅读应用会在用户达到某些阅读里程碑时解锁动画。如果你把阅读弄得像一件苦差、一道日常“洁脑”程序，其实就是告诉读者他们的文化素养也就是一只獏的水平。

第二个需要留心的相关方在近年才出现，那就是监管官员。游戏化意味着鼓励人们在某件事情上多花一些功夫。如果是让他们学习日语，那很好。但如果是让他们多吃猪油，那就不太妙。监管机构美国证券交易委员会（SEC）担心，游戏化的金融交易应用可能会导致投资者执行过多交易，于他们不利，因此开始关注它所说的“数字高参与操作”。随着审查趋严，企业已经开始改变这类行为。被SEC盯上的应用包括Robinhood，去年它在压力之下取消了客户完成首次交易后展示的撒花动画。

第三群人是雇员。据报道，亚马逊在其仓库中使用了一种把重复性工作转化为电子游戏的方法，将工人分拣和装箱的进度以赛车的形式呈现出来。销售员工敬业度软件的公司也往往会用上积分、排行榜和虚拟货币等套路。

这些主意可能适得其反。强制排名对一些人具有激励作用，但也会让另一些人不堪重负。开源编码平台GitHub取消了每日打卡功能，因为有人担心它在诱导程序员每个周末都工作。正如韩所说，如果你无法真正自主选择玩还是不玩，游戏的乐趣就会大打折扣。人为添加乐趣有时可行，但须经过深思熟虑。■



Goodbye 1.5°C

The world is missing its lofty climate targets. Time for some realism

Global warming cannot be limited to 1.5°C

TO ACCEPT THAT the world's average temperature might rise by more than 1.5°C, declared the foreign minister of the Marshall Islands in 2015, would be to sign the "death warrant" of small, low-lying countries such as his. To widespread surprise, the grandees who met in Paris that year, at a climate conference like the one starting in Egypt this week, accepted his argument. They enshrined the goal of limiting global warming to about 1.5°C in the Paris agreement, which sought to co-ordinate national efforts to curb emissions of greenhouse gases.

No one remembered to tell the firing squad, however. The same countries that piously signed the Paris agreement have not cut their emissions enough to meet its targets; in fact global emissions are still growing. The world is already about 1.2°C hotter than it was in pre-industrial times. Given the lasting impact of greenhouse gases already emitted, and the impossibility of stopping emissions overnight, there is no way Earth can now avoid a temperature rise of more than 1.5°C. There is still hope that the overshoot may not be too big, and may be only temporary, but even these consoling possibilities are becoming ever less likely.

The consequences of the world's failure to curb emissions are catastrophic, and not just for coral atolls in the Pacific. Climate-related disasters are proliferating, from Pakistan, much of which was inundated by this summer's unusually intense monsoon, to Florida, which in September endured its deadliest hurricane since 1935. Even less lethal distortions of the weather, such as this summer's extraordinary heatwave in Europe, do enormous economic damage, impeding transport, wrecking infrastructure and sapping productivity.

The response to all this should be a dose of realism. Many activists are reluctant to admit that 1.5°C is a lost cause. But failing to do so prolongs the mistakes made in Paris, where the world's governments adopted a Herculean goal without any plausible plan for reaching it. The delegates gathering in Egypt should be chastened by failure, not lulled by false hope. They need to be more pragmatic, and face up to some hard truths.

First, cutting emissions will require much more money. Roughly speaking, global investment in clean energy needs to triple from today's \$1trn a year, and be concentrated in developing countries, which generate most of today's emissions. Solar and wind power can be cheaper to build and run than more polluting types, but grids need to be rebuilt to cope with the intermittency of the sun and the wind. Concessionary lending and aid from rich countries are essential and a moral imperative. However, the sums required are far greater than what might plausibly be squeezed out of Western donors or multilateral organisations such as the World Bank.

So the governments of developing countries, especially middle-income ones, will have to work with the rich world to mobilise private investment. On the part of developing countries, that will involve big improvements to the investment climate and an acceptance that they will have to cede some control over energy policy. On the part of donors, it will involve focusing spending on schemes that "crowd in" private capital, such as indemnifying investors against political and regulatory risks, taking equity stakes in private projects and agreeing to absorb the first tranche of losses if things go wrong. They will have to do things they dislike, such as helping the poorest countries shut coal plants. But without give on both sides, the world will bake.

The second hard truth is that fossil fuels will not be abandoned overnight. Europe is scrambling to build import facilities for natural gas, having lost access to Russian supplies, precisely because it cannot come up with any

immediate alternative. For some poorer countries investments in gas, in conjunction with renewables, are still necessary: helping more citizens get life-enhancing electricity is a moral imperative, too.

The third truth is that because 1.5°C will be missed, greater efforts must be made to adapt to climate change. Adaptation has always been the neglected step-child of climate policy, mistrusted by activists as a distraction from cutting emissions or, worse, an excuse not to make any cuts. But no matter what, the world now faces more floods, droughts, storms and wildfires. For developing countries especially, but also for rich ones, preparing for these calamities is a matter of life and death.

Fortunately, a lot of adaptation is affordable. It can be as simple as providing farmers with hardier strains of crops and getting cyclone warnings to people in harm's way. Better still, such measures tend to have additional benefits beyond helping people cope with climate change. This is an area where even modest help from rich countries can have a big impact. Yet they are not coughing up the money they have promised to help the poorest ones adapt. That is unfair: why should poor farmers in Africa, who have done almost nothing to make the climate change, be abandoned to suffer as it does? If the rich world allows global warming to ravage already fragile countries, it will inevitably end up paying a price in food shortages and proliferating refugees.

| *Cool it*

Finally, having admitted that the planet will grow dangerously hot, policymakers need to consider more radical ways to cool it. Technologies to suck carbon dioxide out of the atmosphere, now in their infancy, need a lot of attention. So does “solar geoengineering”, which blocks out incoming sunlight. Both are mistrusted by climate activists, the first as a false promise, the second as a scary threat. On solar geoengineering people are right to worry. It could well be dangerous and would be very hard to govern.

But so will an ever hotter world. The worthies in Egypt need to take that on board.

Overshooting 1.5°C does not doom the planet. But it is a death sentence for some people, ways of life, ecosystems, even countries. To let the moment pass without some hard thinking about how to set the world on a better trajectory would be to sign yet more death warrants. ■



【首文】再见了，1.5°C

世界已经无法实现崇高气候目标。务实一些

全球升温无法控制在1.5°C以内

马绍尔群岛的外交部长在2015年宣称，任由世界平均气温上升可能超过1.5°C，就等于是给它们这样地势低洼的小国签发了“死刑执行令”。令大家普遍惊讶的是，当年参加巴黎气候会议（像这周在埃及开幕的会议）的政要们接受了这一观点。他们把控制全球升温在约1.5°C之内的目标写进了协调各国减排行动的《巴黎协定》。

然而，大家却忘了通知“行刑队”。那些郑重其事地签署了《巴黎协定》的国家并没有充分减排来达到其目标，事实上全球排放仍在增长。如今，全球温度已比前工业化时代高出约1.2°C。鉴于已排放的温室气体有持久的影响，而且也不可能一夜之间停止排放，现在看来，地球升温超过1.5°C已是无可避免。仍有希望令超出的幅度不太大且只是暂时性的。但即使这些让人宽心些的可能性也在日益缩小。

世界未能遏制排放的后果是灾难性的，且不仅是对太平洋上的珊瑚环礁而言。气候灾难在激增，比如巴基斯坦在今年夏天出现异常强烈的季风暴雨，大面积国土被淹；佛罗里达在9月遭遇了自1935年以来最致命的飓风袭击。连不那么致命的异常天气也会造成巨大的经济损失，包括阻碍运输、破坏基础设施、削弱生产力，比如今年夏天欧洲的超级热浪。

面对这一切，应该拿出直面现实的态度。许多气候活动人士不愿意承认1.5°C的温控目标已经落空。但若不正视这一现实，巴黎会议所犯的错误就会一直延续，当时各国政府只是订下艰巨的目标，却没有拿出实现目标的可行计划。这次聚首埃及的各国代表们应从失败中汲取教训，不再被虚幻的希望麻醉。他们需要更加务实，直面一些残酷现实。

首先，减排所需的资金会远超已有投入。粗略估计，全球对清洁能源的投资需要达到目前每年一万亿美元的三倍，而且要集中投向造成当前大部分

排放的发展中国家。太阳能和风能发电设施的造价和运营成本都比污染更严重的发电设施要低，但需要改造电网以适应光电和风电的间歇性特性。富裕国家给予优惠贷款和援助是关键，道义上也必须这么做。然而，所需资金之巨，远超过可能让西方捐助者或世界银行等多边组织拿出来的数额。

所以，发展中国家的政府，特别是中等收入国家的政府，将不得不与富国合作来动员私人投资。在发展中国家这一边，这将涉及大力改善投资环境，接受将不得不让渡一些对能源政策的控制。在捐助方这一边，将需要把支出集中投向促进私人资本“涌入”的计划上，例如保护投资者免受政治及监管风险的影响，入股私人项目并同意在发生问题时承担初期损失。他们将被迫做一些自己不喜欢的事情，比如帮助一些最穷的国家关闭燃煤电厂。但是，如果没有来自双方的让步，世界将变得酷热难耐。

第二个残酷现实是，化石燃料不会在一夜之间被舍弃。欧洲在失去俄罗斯的供应后正在争相建造新的天然气进口设施，这正是因为没有立即可用的替代品。对于一些较贫穷的国家而言，在发展可再生能源之外投资于天然气仍是必需的，因为让更多国民能用上电来改善生活也是一种道义责任。

第三个现实是，既然1.5°C的温控目标已无法实现，就必须做更多事情以适应气候变化。适应在气候政策中一直不受待见，气候活动人士不买账，认为这是在分散对减排的努力甚或用作不减排的借口。但无论如何，现在洪水、干旱、风暴和山火等灾害日益频繁。做好应对预案生死攸关，特别是在发展中国家，但对富裕国家来说也一样。

幸运的是，许多适应措施都是负担得起的。它们可以是非常简单的，比如为农民提供耐受性更强的农作物品种，在台风来袭前向可能受影响的人们发出警报。更妙的是，这些措施除了能帮助人们应对气候变化，往往还有其他好处。在这方面，即便是富国提供的些许帮助也能产生很大的作用。但是这些国家并没有兑现出资的承诺来帮助最穷的国家适应气候变化。这是不公平的：非洲的贫困农民几乎没有做任何事情导致气候变暖，为何却要孤立无援地承受其后果？假如富裕世界放任全球变暖冲击本已脆弱不堪

的国家，它们最终将付出粮食短缺和难民激增的代价。

| 降温

最后，在承认地球变暖会向危险的方向发展后，政策制定者需要考虑采取更激进的方法来为地球降温。从大气中吸走二氧化碳的技术现在仍处于起步阶段，需要多加关注。阻挡阳光射入的“太阳地球工程”也是如此。气候活动人士对这两者均持怀疑态度，认为前者是在画大饼，后者更是个可怕的威胁。人们对太阳地球工程的担忧是有道理的。它很可能是危险的且很难规管。但是地球越来越热也一样危险。在埃及开会的政要们需要考虑到这一点。

升温超过1.5°C并不会导致地球灭亡。但对一些人、一些生活方式、一些生态系统，甚至一些国家来说，这就是被判死刑。不抓紧时间认真思考怎样让世界走上一个更好的轨道，无异于发出更多死刑执行令。■



Business in America

Facebook and the conglomerate curse

Beset by bloating and egomania, big tech would benefit from active boards and investors

IN 1997, IN HIS first letter to shareholders, Jeff Bezos, Amazon's founder, wrote that it was still "Day 1" for his firm. Day 2, he later explained, would mean stasis, followed by irrelevance. His rousing call to avoid complacency seems apt today. Silicon Valley's five big tech giants, Alphabet, Amazon, Apple, Meta and Microsoft, have long been the bedrock of America's stockmarket and economy, miraculously combining reliable growth and profitability. But after a torrid third quarter their market capitalisations have now collectively dropped by 37% so far this year. About \$3.7trn of value has evaporated.

The law of large numbers made it inevitable that the tech giants would mature. Sales growth in the last quarter slowed to 9%—barely above inflation. As they have grown bigger, they have become tied to the economic cycle; a fact which the digital surge during the pandemic only temporarily masked. Penetration rates for smartphones, digital advertising and streaming are plateauing. With slowing core businesses, the giants are venturing onto each other's turf, increasing competition.

Meanwhile, they are threatened by "conglomeritis". The symptoms of this disease are bloating and egomania. Consider the recent orgy of spending on hiring, experimental ventures, vanity projects and building data centres. In March the five firms' combined annual expenses reached \$1trn for the first time, and the value of the physical plant of these supposedly asset-light businesses has reached \$600bn, over triple the level of five years ago. Swollen costs and balance-sheets mean returns on capital have fallen from over 60% five years ago to 26%. Three of the five do not deign to pay

dividends.

It is hardly unprecedented for successful companies to lose their focus, or to fail to control costs. In the 1980s RJR Nabisco's executives splurged on jets and golf before being ousted by private equity's barbarians. General Electric sprawled and had to be partially bailed out during the financial crisis of 2008-09. The best safeguards against such indiscipline are active boards and investors. When successful managers start to believe that they always know best, it is the board's job to rein them in.

But here, the tech firms' governance rules add a twist. Often they entrust disproportionate power to bosses and founders, some of whom enjoy special voting rights that give them near-absolute control. Such bosses often cultivate an image as visionaries, whose daring bets horrify myopic outsiders but end up lucratively transforming the world.

At the worst end of the spectrum is Meta, the owner of Facebook, run increasingly erratically by Mark Zuckerberg. Its value has dropped by 74% this year. Its core business is wobbly, attracting too much toxicity, too few young people and too little advertising. It has become clear that Mr Zuckerberg is betting the firm on the metaverse, an attempt to diversify away from social media, on which he plans to lavish 20 times what Apple spent to build the first iPhone. Because dual share classes give him 54% of voting rights, Mr Zuckerberg has been able to ignore the pleas of outside investors. Alphabet, the owner of Google, has performed better but is flabby. Its founders retain 51% of its voting rights, allowing them to overrule the wishes of other owners.

In the middle is Amazon, which has over-invested in e-commerce and expanded too far, crushing its cashflow and returns. Mr Bezos, who remains executive chairman, owns less than 15% of the firm's voting rights, so he has to be at least somewhat responsive to investors. Apple and

Microsoft are at the benign end of the spectrum. Both firms are older, no longer have founders with controlling stakes and operate on the principle of one share, one vote. Both listen to outsiders. In 2013 Tim Cook, Apple's boss, sat down for dinner with Carl Icahn, a fiery investor, and took on board his request to return money to shareholders through buybacks. In 2014 Microsoft invited an activist investor, Mason Morfit, onto its board. The two firms have performed the best of the big five this year.

When you have disrupted industries and created hundreds of billions of dollars of wealth it is hard to accept financial constraints and outside scrutiny. Nonetheless, many in big tech's elite need to show more humility and better performance. Otherwise Day 3 might bring an escalating confrontation between them and investors over who controls the most successful firms of the past two decades. ■



【首文】美国商业

Facebook与超大公司诅咒

积极的董事会和投资者对臃肿又自大的科技巨头有益

一九九七年，亚马逊创始人杰夫·贝索斯在第一封致股东信中写道，他的公司现在仍处在刚成立的“第一天”。他后来解释说，第二天意味着公司已是一潭死水，再往后就无人问津了。他为避免自满而发出的激昂呼吁在今天听来特别应景。Alphabet、亚马逊、苹果、Meta和微软这硅谷五大科技巨头长期以来一直是美国股市和经济的基石，奇迹般地兼顾了可靠的增长和盈利。但在经历了艰难的第三季度之后，今年到目前为止，它们的市值已经集体下跌37%。大约3.7万亿美元的市值灰飞烟灭。

根据大数定律，科技巨头进入平台期是无法避免的。上一季度的销售增长放缓至9%，勉强高于通胀。随着它们规模越来越大，它们的发展已与经济周期捆绑在一起，疫情期间的数字热潮只是暂时掩盖了这一事实。智能手机、数字广告和流媒体的渗透率正在趋于平稳。随着核心业务放缓，巨头们正在涉足彼此的地盘，加剧了竞争。

与此同时，它们容易患上“大公司病”。这种病的症状是组织臃肿和自大狂。看看巨头们最近在招聘、实验性项目、面子工程和建设数据中心上砸了多少钱吧。3月，五巨头的年度总支出首次达到1万亿美元，而且这些号称轻资产的公司的实体工厂价值已达6000亿美元，是五年前的三倍多。上涨的成本和膨胀的资产负债表导致资本回报率从五年前的60%以上降到了26%。五巨头中有三家今年不打算支付股息。

成功的公司失去焦点或未能控制好成本不乏前例。上世纪80年代，雷诺兹-纳贝斯克（RJR Nabisco）的高管在喷气式飞机和高尔夫上大把烧钱，后来被像野蛮人一样出现的私募股权赶下台。通用电气（GE）扩张无度，在2008至2009年金融危机期间部分业务不得不接受纾困。对于这种缺乏自律的行为，最能起到防范作用的是积极主动的董事会和投资者。一旦成功的管理者开始觉得自己总是最懂行的那个，董事会就需要对他们加以约

束。

但科技公司的治理规则加大了约束的难度。这些规则经常赋予老板和创始人过大的权力，其中一些人享有特殊投票权，让他们几乎拥有绝对的控制权。这样的老板通常会给自己塑造这样的形象：富有远见卓识，敢于大胆押注，让目光短浅的局外人目瞪口呆，但最终在改变世界的同时还能大赚一笔。

最缺乏约束的是Facebook的母公司Meta，在马克·扎克伯格的领导下，它的经营方向越来越难以捉摸。公司股价今年下跌了74%。它的核心业务很不稳定，负面消息太多，年轻用户和广告太少。很明显，扎克伯格将公司的未来押在了元宇宙上，试图在社交媒体之外实现多元化。他计划在元宇宙上投入20倍于苹果打造第一款iPhone时的费用。由于双重股权结构赋予了扎克伯格54%的投票权，他能够无视外部投资者的请求。谷歌的母公司Alphabet比Meta股价表现更好，但也发展乏力。其创始人享有51%的投票权，可以否决其他股东的提议。

约束程度居中的是亚马逊，它在电子商务上投资过度，且扩张过头，现金流和投资回报大幅下降。仍担任董事会执行主席的贝索斯拥有该公司不到15%的投票权，因此他对投资者的意见至少要有所回应。苹果和微软在约束方面表现较好。两家公司成立时间都更长，不再有能控股公司的创始人，按照一股一票的原则运作。两家公司都会倾听外部人士的意见。2013年，苹果的老板蒂姆·库克与激进投资人卡尔·伊坎（Carl Icahn）共进晚餐，并接受了他提出的通过回购股票向股东返还现金的要求。2014年，微软邀请维权投资者梅森·墨菲特（Mason Morfit）加入董事会。这两家公司今年在五巨头中表现最好。

当你颠覆了行业并创造了数千亿美元的财富时，会很难接受财务约束和外部监督。但是，大型科技公司的众多精英需要表现得更谦逊，并拿出更好的业绩。否则到了第三天，他们与投资者间的对抗可能会不断升级，为了谁控制过去二十年间最成功的公司闹得不可开交。 ■



Ren-naissance

Can Huawei thrive despite American sanctions?

Ren Zhengfei, its boss, has big plans

HUAWEI ONCE looked unstoppable. Having begun life in 1987 selling phone switches from a flat in the southern city of Shenzhen, in 2012 the Chinese technology firm overtook Sweden's Ericsson to become the world's biggest maker of telecoms gear. By 2020 its market share topped 30%, roughly as much as Ericsson and Nokia of Finland, its two main rivals, combined. The same year it surpassed Samsung as the largest maker of smartphones. Its fast-growing software and cloud-computing businesses were beginning to compete with America's IBM and Oracle.

The American government had other plans. Successive administrations have regarded Huawei as a national-security risk, claiming that it has deep links with the People's Liberation Army and that its gear could be used for spying (allegations that have not been proven and that Huawei denies). The American government has banned Huawei's wares at home and urged allies to ditch them from their 5G mobile networks. Most crippling, it used export controls to starve the company of American technology and products, including computer chips, on which many manufacturers rely. In the latest blow, on October 24th the Department of Justice said it had indicted two Chinese spies for attempting to obtain inside information about a federal investigation into Huawei.

All this has turned a company on track to be one of the world's biggest into its most controversial. The results have been devastating. After years of uninterrupted growth Huawei's sales collapsed by nearly 30% in 2021, from a peak of almost \$140bn the year before (see chart 1). Huawei said on October 27th that the decline in the revenue of its devices business had slowed in the first nine months of 2022. Total revenue grew by about 6.5%

in the third quarter, year on year. As countries across the globe roll out 5G, Huawei's market share for telecoms networks—its main business—looks set to decline. Its international mobile-phone business is dead, insiders say. The company's 78-year-old founder and boss, Ren Zhengfei, recently told employees in a leaked memo that the company was in a fight for survival.

To prevail in that fight, Mr Ren is transforming the company from one laser-focused on a few core telecoms products to a provider of tech and services to a variety of industries, from carmaking to agribusiness. Whether this transformation can succeed matters not just for Huawei. America's campaign to forestall China's rise as a technological superpower is intensifying. Last month Joe Biden's administration announced new restrictions, covering more Chinese firms and more areas where Washington and Beijing are vying for dominance, such as artificial intelligence and supercomputing. Huawei is thus a case study in how effective American sanctions really are, how Chinese firms can adapt to the new world order and, ultimately, whether China has a shot at winning the tech race.

| *Immobile network*

America's first anti-Huawei weapon has been to block its global 5G roll-out. Geographically, the results have been mixed. America's strategy is working in the rich Western markets of its allies. Australia, Canada, New Zealand and Sweden have followed America in banning Huawei gear outright. New rules in Britain force carriers to remove all Huawei technology from public 5G systems by 2027. France has asked operators to rip out Huawei gear from many parts of their networks. Other countries, such as Japan, have not barred Huawei but signalled that it is unwelcome. The constant risk of fresh restrictions has led many customers in places without bans to steer clear of Huawei. This has already happened in Italy and Portugal.

The developing world still seems open to Huawei's cheap equipment. The company is furnishing 5G networks in Indonesia, Saudi Arabia, South Africa and Turkey. Brazil, another potentially large market, has flip-flopped but does not appear poised to issue a ban. Huawei executives boast of more than 5,000 commercial 5G contracts globally, ranging from full deployment of 5G networks for national carriers to upgrading networks at ports.

How many more such agreements it can sign depends in part on the effectiveness of American export controls, the second weapon deployed against Huawei. These restrictions, which since 2019 have limited the sale to the company of high-end chips and Google's Android mobile operating system, have already obliterated the firm's once-thriving smartphone business. Huawei's own operating system, Harmony, is unattractive to consumers since it offers few apps, and it offers few apps because it lacks the consumer numbers that would make it worth developers' while. The chip ban, meanwhile, means that even though it has built much of China's 5G infrastructure, its phones lack 5G because the required radio chips rely on American tech. This forced Huawei to spin off its Honor smartphone brand in 2020. Revenues from Huawei's remaining devices business fell by 25% in the first half of 2022, compared with a year earlier.

The impact of the chip ban on the carrier business is a closely guarded secret. The processors used in network gear are less advanced than those used in smartphones, and some of them could be produced locally by chipmakers such as SMIC, a state-controlled firm. But probably not all, at least in the near future. The Tiangang processor, designed by Huawei's HiSilicon chip division for use in 5G networks, was fabricated by TSMC, a giant Taiwanese contract manufacturer that can no longer supply Huawei as a result of the American rules. Publicly, Huawei claims to be shipping units as normal, thanks to a stockpile. But that "will start to run out very shortly", predicts Bill Ray of Gartner, a consultancy.

The company's behaviour in tenders for carrier contracts suggests as much. In the past 18 months Huawei has routinely bid the highest allowed price. This implies that it is trying to maximise profits while conserving its component inventories rather than seeking market share, says Edison Lee of Jefferies, an investment bank. According to disclosures on a large tender for China Mobile analysed by Jefferies, Huawei equipment accounts for 47% of China Mobile's locally manufactured servers, down from 61% last year.

Globally, the company's share of telecoms-gear revenues has so far declined by less than two percentage points from its peak of more than 30% in 2020, according to Dell'Oro, a research firm (see chart 2). But Huawei's global sales of such equipment still fell by 7% last year. Much of its remaining revenue comes from China and, abroad, from less lucrative 4G networks, which are still being built in poorer countries. As investment in China's 5G roll-out winds down, moreover, Huawei's global market share may be eroded further, points out Stefan Pongratz of Dell'Oro. The idea of saving the foreign 5G business by selling its intellectual property to a Western owner, which Mr Ren entertained in an interview with *The Economist* in 2019, appears to have been shelved.

Mr Ren nevertheless remains undaunted. His leaked memo in late August, in which he asks staff to "feel the chill" brought on by gloomy economic conditions in China and abroad, should be read not as an act of despair but as his way of rallying the troops, insist some executives. And there is plenty for Mr Ren's troops to rally round. He wants Huawei to become a purveyor of technology to a wide spectrum of industries. It has already sold 300m devices running on Harmony, including laptops, wearables such as smart watches and app-controlled home appliances. Last month the *Financial Times* reported that it may attempt to relaunch the production of 5G phones using less advanced chips.

And it is venturing beyond gadgets and telecoms. It is making sensors to monitor soil conditions to help farmers fine-tune irrigation systems and cut back on fertiliser. It is building a business in systems for clean-power generation. It has also become a big supplier of software and electronics for carmakers, with which it has teamed up to develop various bespoke systems, such as energy management for electric vehicles. Huawei says that in July alone it had sold more than 7,200 AITO M5s, a model of car jointly developed with Seres, a Chinese-owned electric-vehicle maker based in California.

It is also expanding its enterprise division. The unit is building data centres and cloud-computing businesses around the world. Its prospects look strong in China, where the chief source of demand over the next decade will be the government (as provincial and city authorities upgrade their systems to offer more public services online) and state-owned firms (which are frantically digitising and installing the industrial “internet of things”).

| *The rise of IaaS men*

Huawei does not enjoy a technical advantage in such “infrastructure as a service” (IaaS) over giant local rivals like Alibaba and Tencent. But it has the government connections needed to win the juiciest contracts, says Yi Zhang of Canalys, a research firm. In just a few years this has helped Huawei become the second-largest cloud provider in China, behind Alibaba. Many Chinese firms are tossing out Oracle databases and asking Chinese companies to build local ones. Huawei is scooping up this business. As revenues from devices tumbled in the first half of 2022, its overall sales from the enterprise division surged by 28% to 55bn yuan (\$7.6bn), or about 18% of total revenues. Gartner reckons that Huawei has become the world’s fifth-largest IaaS provider.

Maintaining a presence in foreign markets poses a bigger challenge. Mr Ren has long understood the importance of grabbing global market share. In the

late 1990s he began deploying staff to far-flung places in Africa and South America to forge local connections. The strategy helped make Huawei China's first genuinely multinational corporation. Huawei's new businesses are not expected to make headway in America. But the company thinks much of the rest of the world is fair game. Its energy-management products are growing fast in Europe. One insider points out that over the past three years Huawei has been building up its foreign IaaS engineering capabilities in Africa, Latin America, the Middle East and South-East Asia.

However, barriers to entry in such businesses are high even in places that welcome Huawei. Much of the world's information technology runs on software from Microsoft, an American giant. Huawei's databases use Linux, an open-source operating system. The technical difficulty of installing Huawei to replace American systems that run on Oracle's and IBM's products, which are much more compatible with Microsoft's, is high, says Boris Van of Bernstein, a broker. Edging out the American firms in China is one thing; doing so abroad is quite another. And although Mr Ren has amassed heaps of chips needed for its enterprise products, the new American rules will make these harder to replenish.

Taken together the changes amount to a revolution in how Huawei functions as a business. In the past its sprawling research-and-development (R&D) operation dreamed up new technologies, its engineers developed them into a limited range of core products and its sales team sold those to customers in two main sectors: telecoms and consumer electronics. This one-way end-to-end system is being replaced by a more open, two-way model, where Huawei develops products in partnership with its growing array of client industries. People close to the group say it now resembles a vast web of startups with deep R&D coffers. The company often spends 20% of annual revenues on R&D, the same share as Meta and nearly twice as much as Alphabet. That amounts to about \$122bn over the past decade.

Mr Ren could yet pull off the transformation. His company's 100,000 engineers have an enviable record of inventiveness. Yet it is hard to imagine Huawei regaining its global clout, especially as President Xi Jinping consolidates his power and ratchets up tensions with the West.

On October 24th, after Mr Xi named a team of loyalists to run the country for the next five years, investors fled Chinese stocks. Hong Kong's Hang Seng index fell by more than 6%. Many big tech companies lost 10-20% of their value. Alibaba's shares were trading at below the price at the e-emporium's initial public offering in 2014.

As a private company, part-owned by its employees, Huawei is not directly affected by the stockmarket turmoil. But it is not immune to the geopolitical gales buffeting public markets. Rather than the next Apple or Microsoft, Huawei's new ventures may eventually look a bit more like Accenture, an American-listed firm that advises companies on technology transitions, says Mr Van. That would not be all bad: Accenture has a market capitalisation of \$185bn. But it is far more modest than Huawei's multitrillion-dollar global promise of yore. ■



复兴“任”务

受到美国制裁的华为还能蓬勃发展吗？

老板任正非有鸿图大计【深度】

华为一度看似势不可挡。这家中国科技公司成立于1987年，最初在深圳的一间公寓里销售电话交换机。它在2012年超越瑞典的爱立信，成为全球最大的电信设备制造商。到2020年，它的市场份额超过30%，大致相当于两个主要竞争对手爱立信和芬兰公司诺基亚的总和。同年，它超越三星成为最大的智能手机制造商。它快速增长的软件和云计算业务开始与美国的IBM和甲骨文竞争。

美国政府对华为的走向却另有想法。近几届美国政府都将华为视为国家安全威胁，称它与中国军方关系密切，其设备可能用于间谍活动（这些指控未得到证实，华为也予以否认）。美国政府已在国内禁用华为的设备，并敦促盟国将它们剔除出自己的5G移动网络。对华为影响最大的是美国采取出口管制措施，令它无法获得包括计算机芯片在内的许多制造商都依赖的美国技术和产品。在最近的一记打击中，美国司法部于10月24日表示已起诉两名中国间谍，指控他们试图获取司法部调查华为的内幕信息。

这一切让一家正迈向全球最大之列的企业变成了最具争议的。其后果是毁灭性的。华为多年不间断的增长在2021年被打破，销售额从2020年1400亿美元的最高点陡降近30%（见图表1）。华为在10月27日表示，2022年前九个月，其设备业务收入的下跌幅度已有所放缓，第三季度总收入同比增长约6.5%。随着世界各国铺开5G网络，华为的主要业务电信网络的市场份额看起来势必会下降。内部人士说它的国际手机业务已经覆灭。根据一封泄露出来的内部信，华为78岁的创始人兼老板任正非最近告诉员工，公司正处在生存危机点上。

为了赢得这场生存之战，任正非正在将公司从专注少数核心电信产品转变为向从汽车制造到农业经营等各个行业提供技术和服。这种转型能否成功不仅仅关乎华为自身命运。美国正在加大力度阻遏中国崛起为科技超级

大国。上月，拜登政府宣布了新的限制措施，覆盖了更多中国公司以及华盛顿和北京争夺主导地位的更多领域，如人工智能和超级计算。华为因而是一个值得关注的案例，通过它可以观察美国的制裁是否真的有效、中国公司如何能适应新的世界秩序，以及最终中国是否有机会赢得这场科技竞赛。

| 非移动网络

美国压制华为的第一件武器是阻止其全球5G部署。从地理上看，结果成败参半。美国的战略在它那些富裕西方盟友的市场上起了效果。澳大利亚、加拿大、新西兰和瑞典跟随美国彻底禁用了华为的设备。英国的新规定强制运营商在2027年之前从公共5G系统中移除所有华为技术。法国要求运营商从其网络的许多部分中移除华为设备。日本等其他国家虽未禁用华为，但也表示不欢迎。总有可能出现新限制措施，这导致在没有禁令的地方许多客户也开始避开华为。这种情况在意大利和葡萄牙已经出现。

发展中国家似乎仍然对华为的廉价设备持开放态度。该公司正在印度尼西亚、沙特阿拉伯、南非和土耳其建设5G网络。巴西是另一个潜在的大市场，它的态度摇摆不定，但似乎并不准备发布禁令。华为高管称公司在全球拥有超过5000份商用5G合同，既有为国家级运营商全面部署5G网络，也有升级港口网络等项目。

华为还能签下多少这样的合同在一定程度上取决于美国出口管制的效力，这是压制华为的第二件武器。自2019年以来，这些出口管制措施限制了对华为出售高端芯片和谷歌的安卓移动操作系统，已经摧毁了这家公司一度繁荣的智能手机业务。华为自己的操作系统鸿蒙对消费者缺乏吸引力，因为它提供的应用很少，而应用少又是因为消费者数量不足，不值得开发者花时间开发。与此同时，芯片禁令意味着尽管华为建设了中国的大部分5G基础设施，但其手机仍不能支持5G网络，因为所需的射频芯片依赖美国技术。这迫使华为在2020年剥离了其智能手机品牌荣耀。2022年上半年，华为剩余的设备业务的收入同比下降了25%。

华为对芯片禁令对其运营商业务的影响守口如瓶。网络设备中的处理器没

有智能手机中的那么先进，其中一些可以由国有控股公司中芯国际等芯片制造商在本地生产。但可能没法全部在本地生产，至少在近期不太可能实现。由华为芯片部门海思设计的5G网络处理器天罡之前由代工巨头台积电制造，而由于美国的禁令，台积电无法再向华为供货。在公开场合，华为声称库存仍可保证正常出货。但咨询公司高德纳（Gartner）的比尔·雷（Bill Ray）预测说，库存“很快就会开始耗尽”。

华为在投标运营商合同时的做法也透露出这一点。在过去的18个月中，华为的出价总是最高投标限价。投资银行杰富瑞（Jefferies）的李裕生表示，这表明它试图在节省零部件库存的同时实现利润最大化，而不是寻求市场份额。根据杰富瑞公布的对中国移动通信公司的一项大型招标的分析，华为设备目前在中国移动本地制造的服务器中占47%，低于去年的61%。

根据研究公司Dell'Oro的数据，到目前为止，华为在全球电信设备收入中的占比从2020年超过30%的峰值下降了不到两个百分点（见图表2）。但去年它这类设备的全球销售额还是下降了7%。这部分收入目前大部分来自中国国内，以及国外利润较低的4G网络，这些网络在较贫穷的国家仍在建设。Dell'Oro的斯特凡·庞格拉茨（Stefan Pongratz）指出，随着中国部署5G的投资逐渐完成，华为的全球市场份额可能会进一步缩减。任正非在2019年接受本刊采访时曾提到可以考虑把公司的知识产权出售给西方公司来拯救海外5G业务，如今这个想法似乎已被搁置。

不过任正非仍不气馁。在8月下旬泄露的内部信中，他要求把中国和海外经济低迷带来的“寒气传递给每个人”。一些高管坚称这不应被解读为绝望的感慨，而是他鼓舞员工的方式。也确实有很多地方需要他集结兵力。任正非希望华为能成为各行各业的技术供应商。它已经售出了3亿台鸿蒙设备，包括笔记本电脑、智能手表等可穿戴设备和用手机应用控制的智能家电。《金融时报》上月报道称，它可能会尝试使用不太先进的芯片重启5G手机的生产。

华为正在涉足电子产品和电信以外的领域。它正在生产用于监测土壤状况

的传感器，可以帮助农民调节灌溉系统和减少化肥用量。它正在建立清洁发电系统的业务。它还成了汽车制造商的软件和电子产品的大供应商，与它们合作开发电动汽车能源管理等各种定制系统。华为表示，仅在7月，它就售出了7200多辆问界M5，这是它与总部位于美国加州的中国电动汽车制造商赛力斯联合开发的一款汽车。

华为还在扩大其企业业务部门，该部门正在世界各地建立数据中心和云计算业务。它在中国的前景看起来十分强劲，未来十年，中国在这些方面的需求将主要来自政府（省市级政府将逐步升级系统以提供更多在线公共服务）和国企（它们正在抓紧推进数字化和工业物联网的建设）。

| IaaS人的崛起

在这类“基础设施即服务”（IaaS）业务上，华为相比阿里巴巴和腾讯等本土巨头竞争对手并不具有技术优势。但它拥有赢得最有利可图的合同所需的政府关系，研究公司Canalys的张毅表示。这已帮助华为在短短几年内成为中国第二大云供应商，仅次于阿里巴巴。许多中国公司正在弃用甲骨文数据库，请中国公司来搭建本地数据库。华为正在赢得大量此类业务。它的设备收入在2022年上半年虽然大幅下滑，但其企业业务的整体销售额猛增了28%，达到550亿元，约占总收入的18%。高德纳估计，华为已成为全球第五大IaaS供应商。

更大的挑战是如何保有海外市场份额。任正非早就明白抢占全球市场份额的重要性。上世纪90年代后期，他就开始向非洲和南美洲的偏远地区派驻员工，在当地打造业务关系。这一策略帮助华为成为中国第一家真正意义上的跨国公司。华为的新业务预计不会在美国取得进展，但该公司认为世界上其他大部分地区还是可以积极争取的。它的能源管理产品在欧洲发展迅速。一位内部人士指出，过去三年来，华为一直在非洲、拉丁美洲、中东和东南亚建立其海外IaaS工程能力。

然而，即使在华为受欢迎的地方，此类业务的准入门槛也很高。世界上大部分的IT系统都使用美国巨头微软的软件运行。华为的数据库用的是开源操作系统Linux。经纪公司盛博的鲍里斯·范（Boris Van）说，用华为的

系统来取代用甲骨文和IBM的产品运行的美国系统有很高的技术难度，因为这些系统与微软产品的兼容性要好得多。在中国排挤美国公司是一回事，在国外这样做可就是另一回事了。而尽管任正非囤积了大量企业产品所需的芯片，但美国的新规定将让这部分库存更难被补充。

这些变化一起构成了华为在企业运作方式上的一场革命。过去，其庞大的研发部门发明出新技术，工程师队伍把这些技术变成品种有限的核心产品，销售团队再将这些产品销售给电信和消费电子产品这两个主要领域里的客户。这种单向端到端的系统正在被一种更加开放的双向模式取代，即与不断增长的各行各业里的客户合作开发产品。与华为关系密切的人士表示，它现在类似于一个拥有大量研发资金的庞大的创业公司网络。华为通常将20%的年收入用于研发，这个水平与Meta相同，几乎是Alphabet的两倍。这相当于在过去十年共投入了约1220亿美元。

任正非并非没有机会转型成功。他公司的工程师有十万之众，已经展现出令人羡慕的发明创造力。然而，很难想象华为能够重新获得曾经的全球影响力，尤其是在国家主席习近平巩固了个人权力并升级了与西方的紧张关系的情况下。

10月24日，习任命了由其忠诚跟随者构成的团队在未来五年管理国家，投资者随之纷纷抛售中国股票。香港恒生指数下跌超过6%。许多大型科技公司的市值蒸发了10%至20%。电商平台阿里巴巴的股价跌破了它在2014年上市时的价格。

作为一家由员工部分持股的私营公司，华为并未直接受到股市震荡的影响。但它也不对冲击公共市场的地缘政治风暴免疫。范说，转型之后的华为最终可能不会像下一个苹果或微软，而是更有点像为企业提供技术转型咨询的美国上市公司埃森哲。这倒也不赖，毕竟埃森哲有着1850亿美元的市值。但比起昔日万亿美元全球巨擘的前景，还是小巫见大巫了。■



Inflation

The Fed delivers another jumbo rate rise, and it's far from done

There is a good chance it will keep rates high for longer than investors expect

AS RECENTLY AS the start of June investors and analysts believed that a “jumbo” interest-rate rise for the Federal Reserve meant half a percentage point. How quaint. After four straight increases of three-quarters of a percentage point—the latest on November 2nd—perceptions have changed. Indeed, a stockmarket rally in the two weeks before the announcement was rooted in the belief that the Fed may scale down to a half-point rate increase at its next meeting in December. What was once jumbo is now moderate.

Whether the Fed will in fact downshift to a half-point increase is a matter for debate. Bond pricing assigns roughly even odds to the central bank opting for that smaller increment versus yet another three-quarter-point increase. At a news conference following the Fed's latest move, Jerome Powell, the central bank's chairman, resisted tipping his hand in either direction. And for good reason: inflation figures for both October and November will be published before the Fed's next meeting, and go a long way to determining what it does. There is little sense in guessing the outcome before seeing that data.

But the focus on the size of the rise is also too narrow. As Mr Powell notes, the Fed's tightening of monetary policy can be looked at in three dimensions: how quickly it raises rates, how high it raises them and how long it then keeps them there. The first dimension is already clear. Although the Fed was late in launching its rate-rise cycle, it has moved with alacrity since starting, raising short-term borrowing rates from 0% in March to 3.75% now—its most aggressive increase in four decades.

The second dimension is also becoming clearer. In September the median expectation of Fed officials was that rates would peak at 4.6% next year. Bond pricing now has the peak pegged at 5%, reflecting the fact that a variety of inflation indicators have stayed stubbornly high. Mr Powell suggested that the Fed's thinking is in line with the bond market. Even so, there is a logic for slightly smaller increases from here on. Just as an aeroplane slows before landing, so, ideally, does a central bank before settling on its peak rate.

The biggest uncertainty surrounds the final dimension. How long will the Fed need to keep rates at a restrictive level? It estimates that the long-term neutral level—that which is neither inflationary nor stimulative—is about 2.5%. By this yardstick, nominal rates are already in restrictive territory. But in real terms, with inflation still running at more than 8% annually, policy remains loose. So the question is when the economy will react to them.

Some developments have been predictable. Mortgage rates have more than doubled over the past year, exceeding 7%. That has led to a sharp fall in house purchases. But the resilience of the labour market has been harder to predict. There are still nearly twice as many job openings as there are unemployed people, placing upward pressure on wages and, in turn, inflation.

At several points during the conference, Mr Powell emphasised that the Fed would keep rates high for as long as is required. Markets have priced in a pivot before the end of 2023. The view is the Fed will trim rates in the second half of the year. But it has raised them faster and higher than investors had expected. There is a good chance it will also keep them high for longer than investors currently expect. ■



通胀

美联储再次大幅加息，离结束还早

美联储维持高利率的时间很可能比投资者预期的长

就在6月初，投资者和分析师们还认为美联储的“大幅”加息就是上调50个基点。完全过时了。在美联储连续四次加息75个基点之后（最近一次是在11月2日），观感已经改变。事实上，最近宣布加息的两周前股市之所以出现反弹，正是因为市场相信美联储可能会在12月的下次议息会议上把加息幅度减至50个基点。曾经的“大幅”如今被视为“温和”了。

美联储是否真会把加息幅度下调至50个基点，对此众说纷纭。从债券定价看，美联储加息50个基点与再度加息75个基点的几率基本持平。在上一次加息后召开的新闻发布会上，主席鲍威尔对这两种可能性不置可否。这有充分的理由：10月和11月的通胀数据将在美联储下次会议前公布，将在很大程度上决定美联储之后的决策。在这些数据出来前猜测结果是没有意义的。

但如果只关注加息幅度就太狭隘了。正如鲍威尔指出的，美联储收紧货币政策可以从三个层面去看：加息速度、加息幅度，以及此后将它们维持在高水平的时长。第一个层面已经很清晰。尽管美联储启动这轮加息周期较晚，但一旦启动之后动作迅速，以令短期借款利率从3月的0%提高到目前的3.75%，是40年来最急速的加息。

第二个层面也日渐明朗。9月，美联储官员对明年利率最高点的预期中位数是4.6%。目前债券定价把利率最高点定在5%，反映出各种通胀指标持续高企的现状。鲍威尔暗示美联储的想法与债券市场一致。即便如此，认为从现在开始加息幅度将略有缩减也有道理。就像飞机在着陆前会减速一样，理想情况下，央行在利率到达最高点前也会减速。

变数最大的是最后一个层面。美联储需要让利率维持在某个限制性水平多久？它估计长期中性水平（既没限制也不刺激经济增长的水平）约为

2.5%。按此标准，名义利率已处于限制性区间。但面对仍超8%的年通胀率，按实际利率来看，货币政策仍属宽松。所以问题在于经济会在何时发生反应。

某些事态发展是可预见的。抵押贷款利率在过去一年翻了一倍多，升至7%以上。这导致购房量骤减。更难预测的是劳动力市场的复原力。目前，职位空缺数量仍为失业人口的近两倍，给工资带来上行压力，进而又造成通胀压力。

在发布会上，鲍威尔几次强调，只要有需要，美联储会一直保持高利率。市场在定价中已经包含了对政策在2023年底前转向的预期，即认为美联储将在明年下半年降息。但美联储加息的速度和幅度均超过了投资者预期。那么它维持高利率的时间也很可能会比投资者目前预期的要长。■



Free exchange

How to escape scientific stagnation

A number of billion-dollar experiments suggest a path

IN 2008 BEN JONES of Northwestern University formalised a simple yet powerful observation. The more knowledge humans have, the longer it takes a budding researcher to get to the frontier, and thus to push things forward. In a paper provocatively titled, “The burden of knowledge and the death of the Renaissance man”, Mr Jones argued humanity’s growing knowledge would slow scientific progress and thus economic growth. More recent research has solidified this view. In 2020 economists at Stanford University and the Massachusetts Institute of Technology (MIT) published another provocatively titled paper, “Are ideas getting harder to find?” which concluded that in areas from crop yields to microchip density, new ideas were indeed getting harder to find.

The slowdown has spurred academics and policymakers looking to bolster scientific enterprise. Many are turning to DARPA, a cold war outfit which funds high-risk “moonshot” research, for inspiration. Last year the National Institutes of Health (NIH), America’s largest science funder, launched a new arm with an annual budget of \$1bn called ARPA-H. Other countries, including Britain and Germany, have set up their own versions. In July America’s Congress authorised nearly \$200bn in new scientific funding over the next decade (although it is yet to stump up the cash), in the process creating a branch of the National Science Foundation (NSF) for applied science and tech. Philanthropists are joining the action, too: their funding of basic research has nearly doubled in the past decade. All these efforts aim to help science get back its risk-loving mojo.

In a working paper published last year, Chiara Franzoni of the POLIMI Graduate School of Management and Paula Stephan of Georgia State

University look at a number of measures of risk, based on analyses of text and the variability of citations. These suggest science's reward structure discourages academics from taking chances. The most common way research is funded, through peer review—in which academics in similar fields score proposals—deserves some blame. In 2017, using a data set of almost 100,000 NIH grant applications, Danielle Li, then of Harvard University, found that reviewers seem to favour ideas similar to their own expertise. If a project must satisfy a committee, it is not surprising that unorthodox ideas struggle to make it through.

This suggests that breaking bad funding habits should make a difference. The DARPA model, which has more in common with venture capital than traditional funding structures, is an attempt to do just that. It empowers programme directors to finance high-risk, high-reward projects with a bent towards real-world use. But though it has proved successful in the defence industry—funding groundbreaking technologies from the early internet to GPS—it may not be quite as successful elsewhere. A book chapter published in February by Ms Li and Pierre Azoulay at MIT notes that the DARPA model does best when its programme directors have a clear understanding of the sort of breakthroughs that are needed. This is often the case at DARPA itself, where both the funder and user of new tech is the defence department. In areas like energy or health care, things are rather less straightforward. The end users are many and dispersed rather than a single government department. Indeed, other work by Mr Azoulay and colleagues notes that although ARPA-E, an energy-focused outfit launched in 2009, is still in its relatively early days, it is yet to produce advances on a par with its defence-orientated predecessor.

Another approach in vogue is to fund “people not projects”. Most conventional grants fund specific projects for a specific amount of time, usually a few years, which researchers worry prevents them from pivoting to new ideas when old ones do not work out and fails to allot enough time

for risky ones to come to fruition. A study in 2011 compared researchers at the Howard Hughes Medical Institute, where they are granted considerable flexibility over their research agendas and lots of time to carry out investigations, with similarly accomplished ones funded by a standard NIH programme. The study found that researchers at the institute took more risks. As a result, they produced nearly twice as much highly cited work, as well as a third more “flops” (articles with fewer citations than their previously least-cited work). These results may be hard to replicate elsewhere. Researchers at the Howard Hughes institute are selected for attributes that suggest they will thrive in such a flexible environment. But the gap is big enough to indicate that others may also benefit from more freedom.

| *The science of science*

Despite the uncertainty about exactly how best to fund scientific research, economists are confident of two things. The first is that a one-size-fits-all approach is not the right answer, says Heidi Williams of Stanford University. DARPA models, the Howard Hughes Medical Institute’s curiosity-driven method, and even handing out grants by lottery, as the New Zealand Health Research Council has tried, all have their uses. Evaluation of them can then build knowledge of what works, says Matt Clancy, an economist who curates a continuously updated online literature survey on innovation, itself an experiment in how to improve science.

The second is that this burst of experimentation must continue. The boss of the NSF, Sethuraman Panchanathan, agrees. He is looking to reassess projects whose reviews are highly variable—a possible indication of unorthodoxy. He is also interested in a Willy Wonka-style funding mechanism called the “Golden Ticket”, which would allow a single reviewer to champion a project even if his or her peers do not agree. Mr Clancy notes that many venture-capital partnerships employ similar policies, because

they prioritise the upside of long-shot projects rather than seeking to minimise failure. Thus far, there is little quantitative evidence on whether Golden Tickets produce Golden Outcomes. All the more reason to try them.





自由交流

如何摆脱科研停滞

多个耗资十亿美元计的实验指向一条新路径

美国西北大学的本·琼斯（Ben Jones）在2008年对一个简单有力的观点做了系统性论述。人类掌握的知识越多，新人研究员要到达前沿领域并推动科研发展就越要耗费更长时间。在一篇标题很有挑动性的论文《知识之重负和全才之死》（The burden of knowledge and the death of the Renaissance man）中，琼斯指出，人类不断积累的知识将使科学进步减慢，进而使经济增长减速。更近期的研究进一步支持了这种观点。2020年，斯坦福大学和麻省理工学院的经济学家发表了另一篇具挑动性标题的论文《创想越来越难找了吗？》（Are ideas getting harder to find?），文章结论是，在从农作物产量到微芯片密度等诸多领域，确实越来越难找到新想法了。

这种减速促使学术界和政策制定者想方设法推动科研发展。许多人想从美国国防高级研究计划局（DARPA，成立于冷战时代，为高风险的“登月”型研究项目拨款）那里寻找启发。去年，美国最大的科研资助机构国立卫生研究院（以下简称NIH）设立了一个年预算达十亿美元的新部门健康高级研究计划署（ARPA-H）。英国和德国等其他国家也建立了类似的机构。7月，美国国会批准在未来十年拨款近2000亿美元（尽管现在还是空头支票）支持新科研项目，期间美国国家科学基金会（以下简称NSF）将新设立一个应用科学技术部门。慈善家们也纷纷加入行动：他们对基础研究的资助在过去十年里几乎翻了个倍。这种种努力都是为了推动科学研究重拾那股爱冒险的劲头。

在去年发表的一篇工作论文中，米兰理工大学管理研究生院（POLIMI Graduate School of Management）的琪亚拉·弗兰佐尼（Chiara Franzoni）和佐治亚州立大学的宝拉·斯蒂芬（Paula Stephan）根据对文本和引用率不稳定性的分析，研究了一些风险衡量指标。结果显示科研的奖励结构并不鼓励学者冒险。通过同行评议（由类似领域的学者评审课

题) 拨付资金这种最常见的科研资助方式要承担部分责任。2017年, 当时在哈佛大学的丹妮尔·李 (Danielle Li) 分析了NIH近十万份拨款申请的数据集, 发现评审者似乎会偏向与自己的研究领域相近的课题。如果一个科研项目必须合乎某个委员会的心意, 一些离经叛道的新奇课题难以通过评审也就不足为奇了。

这表明, 打破糟糕的科研资助传统应该能带来新气象。DARPA的资助模式正是在这个方向上的尝试。相比传统的资助结构, 它更接近风险投资。它授权项目主管拨款支持注重现实应用的高风险、高回报项目。尽管这在国防工业上已经显现成效 (资助了从早期互联网到全球定位系统等开创性技术的研发), 但在其他领域未必能如此成功。丹妮尔·李和麻省理工学院的皮埃尔·阿祖莱 (Pierre Azoulay) 在2月出版的一篇集刊论文中指出, 在项目主管对所需的科研突破有清晰认识的情况下, DARPA模式能发挥最佳作用。DARPA内部往往就是这种情况, 在这里, 美国国防部既是新技术的资助方也是使用方。在能源或医疗等领域, 情况就不那么简单了。终端用户数量众多且分散, 而不只是某一个政府部门。事实上, 阿祖莱与同事们的其他研究发现, 先进能源研究计划署 (ARPA-E, 2009年设立的能源科研机构) 仍处于早期阶段, 尚未取得什么可媲美DARPA的进展。

另一个正时兴的模式是资助“人而非项目”。传统科研拨款都是资助某个项目一段时间, 通常是几年。但研究人员担心这种方式使他们在原有课题行不通时无法转向新课题, 也没有给予足够的时间等待高风险研究出成果。2011年有一项研究比较了霍华德·休斯医学研究所 (Howard Hughes Medical Institute) 的研究人员和由NIH标准项目资助的同等优秀的研究人员。前者在研究进程安排上拥有相当大的灵活性, 而且有大量时间做调查。该研究发现他们选择的研究项目风险更大。结果, 他们产出的高引用论文接近后者的两倍, “失败”率 (被引用次数低于之前引用率最低的文章) 则高三分之一。这些结果也许很难在其他领域复制。这些研究人员之所以会成为霍华德·休斯研究所的成员, 是因为他们本身就显现出能在这种灵活环境中取得成果的特质。但研究中两组对象的成果差距之大, 足以表明其他人也可能从更大的自由度中获益。

| 科学的科学

虽然仍不确定何为最佳科研资助模式，经济学家们对两件事情非常有把握。首先，一刀切的方式不是正解，斯坦福大学的海迪·威廉姆斯（Heidi Williams）表示。DARPA模式、霍华德·休斯医学研究所的好奇心驱动法，乃至新西兰健康研究委员会（New Zealand Health Research Council）尝试过的抽签分配资金的方法都各有用处。对这些方法的评估可以让我们更了解哪些可以奏效，经济学家马特·克兰西（Matt Clancy）指出。他策划管理着一个持续更新的研究创新的线上文献库，这本身也是一场研究如何提振科学的实验。

其次，目前这轮实验的势头必须继续下去。NSF的主任塞瑟拉曼·潘查内森（Sethuraman Panchanathan）认同这一点。他正考虑重新评估那些评审意见差异很大（可能表明本身非同寻常）的项目。他还对一种名为“金票制”的威利·旺卡式资助机制感兴趣，这种机制将允许持“金票”的评审人员在即使其他评审员反对的情况下一票通过项目。克兰西指出，许多风投合伙公司都采用类似的政策，因为他们会优先考虑高风险项目的好处，而非极力避免失败。目前为止，就“金票制”能否带来“黄金成效”的量化证据很少。所以，更有理由来做这样的尝试了。■



Schumpeter

Despite Ukraine, these aren't boom times for American armsmakers

Where's the war bounty?

CAMDEN, A SMALL town in the backwoods of southern Arkansas, is having an unusual brush with the outside world. It is a quiet place. At this time of year there are more Halloween dolls tied to its lampposts than there are people in the streets. It also has a reason to keep its head down. The nearby Highland Industrial Park, which has a few manicured lawns amid thousands of acres of thick forestry, is home to the factories of some of America's biggest weapons manufacturers, such as Lockheed Martin and Raytheon Technologies. "It's been kind of a hidden secret," says Michael Preston, Arkansas's secretary of commerce. Or as a local businessman whispers, "it's a fear thing: 'shhhh'."

The war in Ukraine has made it hard for Camden to remain low-key. Behind high fences and the forest canopy the armsmakers are assembling many of the weapons made famous by Ukrainians who use them to stall the Russian invasion. Javelin missiles, HIMARS guided-missile launchers and GMLRS rockets, known as "gimmlers", have become household names on TV and social media. Politico, a news website, recently profiled Camden as "the struggling Arkansas town that helped stop Russia in its tracks". That has drawn more attention, including from your columnist. He was intrigued that some of these Russia-thumping munitions are stored in bunkers dating back to the second world war. More pertinent, he expected to witness America's military-industrial complex on a full war footing. Instead he discovered just how plodding parts of the American defence juggernaut can be.

In theory, these should be heady times for makers of weapons. Russia's assault on Ukraine, combined with strategic fears about China, have

pushed up America's proposed defence budget for next year, including for procurement of new firepower. Since February America's NATO allies have also promised to spend more on defence, which is likely to bolster demand for American kit, such as Lockheed Martin's F-35 fighter jets. Much of the American weaponry supplied to Ukraine has come from US military stockpiles, which will require a surge in the industry's production capacity to be replenished. The prospect of higher demand, coupled with the view that defence companies are safe investments in times of economic turmoil, has led their stocks to handily outperform the S&P 500 index since February. On October 18th Lockheed Martin's share price jumped by the most in more than two years after its third-quarter results slightly exceeded forecasts.

Drill down, however, and things look much less buoyant. The fillip to Lockheed's shares owed more to its promise to return a slug of cash to shareholders than to any gung-ho predictions about orders. In fact, it expected sales growth to be flat next year and "low single digits" the year after. The view from Camden is equally downbeat. Locals report few signs of a surge in Ukraine-related production, not least because the industry is suffering from the same post-pandemic hangover of rising inflation, supply-chain strains and labour shortages as the rest of American manufacturing. Moreover, the possibility, however slim, that midterm elections in November could alter America's strategic priorities is weighing on people's minds.

The most sobering reality is that the industry is not as stagflation-proof as it appears. Yes, some contracts are "cost-plus", where firms are guaranteed a markup to the unit cost of production. But until Congress approves the new defence budget, many programmes are funded at last year's price levels, which fail to offset costlier material and manpower. This exacerbates the supply-chain problem. As the Centre for Strategic and International Studies, a think-tank, has highlighted, years of consolidation have made

supply lines brittle. Rising prices make suppliers more reluctant to make long-term commitments. That is why companies like Lockheed have been forced to make advance payments to suppliers to set the wheels in motion for higher production—a move that requires big cojones without firm orders from the Pentagon. Furthermore, even as wages rise, it is a struggle to recruit staff. In the Camden area, job postings have long exceeded hirings. The Southern Arkansas University Tech, which trains students in skills such as welding, has recently rebranded its sports teams as “The Rockets” to tout the job opportunities in missile defence.

Part of the problem is that the industry appears in two minds about making heavy weapons. The fastest growing part of defence spending is on snazzy programmes like space and hypersonics. Terrestrial weaponry like vehicles and long-range missiles have been lower-priority. That prompts a former general in Arkansas to gripe that armsmakers often overlook ground forces. Compared with the air force, the army has historically been seen as “just a bunch of dog-faced soldiers trudging in the mud”, he growls.

| *Lady MAGA*

Then there is politics. Normally the likelihood that Republicans would make gains in the midterms would be a cause of optimism in the arms business, because of the party’s hawkish reputation on defence. But as signs plastered across Camden’s lawns remind everyone, the Republican candidate in the Arkansas governor’s race is Sarah Huckabee Sanders, who served as White House press secretary under Donald Trump. That underscores the potential Trumpian influence that may resurface after the elections, dividing consensus on support for Ukraine—and the NATO alliance.

For all that the residents of Camden are hesitant to discuss defence, some believe production will pick up within a few years. The Highland Industrial Park is looking to make space available if suppliers want to move closer to

their customers. The town is considering providing more housing to attract workers. A craft brewery has recently opened in Camden, partly to offer defence workers a nightlife. The town is coming to terms with its new status. That it is doing so only slowly is fine. The military-industrial machine hardly moves at rocket speed either. ■



熊彼特

虽然俄乌开战，美国军火商并没有迎来好光景

战争红利去哪了？

位于美国阿肯色州南部的偏远小镇卡姆登（Camden）罕有地卷入了一场外界纷争。这是个安静的地方。每年这个时候，绑在灯柱上的万圣节鬼娃娃比街上的行人还多。它的低调是有原因的。附近的高地工业园

（Highland Industrial Park，在数千英亩的茂密林地中间有几块修剪整齐的草地）是美国多家军火巨头的工厂所在，如洛克希德·马丁（Lockheed Martin）和雷神技术公司（Raytheon Technologies）。“这算是个隐藏的秘密。”阿肯色州商务厅长迈克尔·普雷斯顿（Michael Preston）说。或者像当地一名商人低声暗示的：“这可是个吓人的事情。‘嘘’。”

俄乌战争令卡姆登难以继续保持低调。在高耸的围栏之后、林木的掩蔽之下，军火商们正在组装许多因乌军用来阻挡俄军入侵而闻名的武器。标枪导弹、海马斯制导火箭炮和俗称“gimmler”的GMLRS火箭弹都在电视和社交媒体上成了家喻户晓的名字。美国新闻网站Politico最近介绍卡姆登时称之为“帮助堵住俄罗斯进犯之路的阿肯色州困顿小镇”。卡姆登因而备受各方关注，包括本专栏作者。他饶有兴致地发现，这些用来打击俄罗斯的军火有一部分是储存在二战时期建造的地堡之内。更重要的是，他本以为能看到准备好了“火力全开”的美国军工复合体，却发现美国军工巨头的某些环节实则步履维艰。

理论上，眼下应该是军火商大感振奋的日子。俄罗斯入侵乌克兰，加上美国对中国的战略担忧，推高了美国明年的国防预算，包括对新军火的采购。自2月以来，美国的北约盟友也承诺提高国防开支，这很可能推高对美国军备的需求，比如洛克希德·马丁的F-35战斗机。提供给乌克兰的大部分美制武器来自美国的军火库存，这部分消耗需要迅速提高美国军工产能才能填补。预计到需求将上升，加上人们认为军火企业在经济动荡时期是安全的投资，美国军工股自2月以来轻松跑赢标普500指数。10月18日，洛克希德·马丁公布第三季度业绩略高于预期，随后其股价出现两年多来

最大涨幅。

但深究起来，情况就远没那么乐观了。洛克希德股价上涨更多是由于它承诺向股东返还大笔现金，而非预测订单猛增。事实上，该公司预计明年销售增长将持平，后年也只会增长“区区几个点”。来自卡姆登的看法也同样悲观。当地人指出，供乌军火生产并没有激增的迹象，尤其是因为该行业与美国其他制造业一样，正饱受通胀上升、供应链吃紧和劳动力短缺等后疫情问题的困扰。此外，11月的中期选举可能改变美国的战略重点，无论可能性有多小，仍是人们心头悬而未决的问题。

最令人警醒的是，这个行业不像看上去那样能抵御滞胀。的确是有些“成本加成”合同，即保证公司能在每件产品的生产成本之外加上一笔利润。但在美国国会通过新国防预算之前，当前许多项目是按去年的价格水平配置资金的，无法抵消材料和人力成本的上升。供应链问题因而加剧。正如智库战略与国际研究中心（Centre for Strategic and International Studies）强调的，多年的整合已导致供应线路变得脆弱。价格上涨令供应商越发不愿做长期保证。这就是为什么洛克希德这类公司会被迫向供应商支付预付款才能推动扩产——在五角大楼还没明确下订单的情况下，扩产需要很大的胆量。此外，工资上涨之时，招聘员工却依旧是个难题。在卡姆登地区，一直是职位空缺多、应聘者少。向学生教授焊接等技能的南阿肯色科技大学（Southern Arkansas University Tech）最近把学校运动队改名为“火箭队”，来宣传导弹制造的工作机会。

问题之一是该行业对制造重型武器的侧重点存在分歧。国防开支中增长最快的是太空和高超音速技术等酷炫项目，车辆和远程导弹等陆地武器的优先等级较低。阿肯色州一位前将军因而抱怨说，军火商常常忽视地面部队。相比空军，陆军向来被认为“不过是一群像狗一样在泥泞中跋涉的士兵”，他低声忿忿道。

| MAGA女士

然后还有政治因素。正常情况下，共和党人在中期选举中胜算更高的前景让人有理由看好军火商，因为共和党在国防问题上向来是鹰派。但正如摆

在卡姆登的草地上的各式标牌提醒人们的，参与竞选阿肯色州州长的共和党候选人是萨拉·赫卡比·桑德斯（Sarah Huckabee Sanders）。她曾在特朗普手下担任白宫新闻发言人，这突显出一个问题：特朗普的影响可能在选举后再次抬头，破坏支持乌克兰和北约联盟的共识。

尽管卡姆登的居民不愿多谈军工产业，一些当地人还是认为生产将在几年内提速。高地工业园正着手开辟空间，欢迎那些想要离客户更近些的供应商进驻。卡姆登也在考虑提供更多住房吸引工人迁入。一家精酿啤酒厂最近在卡姆登开业，一部分考虑是要满足军工业工人的夜生活需要。该镇正在适应新角色。慢慢适应是没问题的。军工业这台大机器也难以按火箭那样的速度运转。■



Biology

Siddhartha Mukherjee's new book is a tour d'horizon of cell theory

He uses examples from his own medical career to underline the importance of cellular understanding

The Song of the Cell. By Siddhartha Mukherjee. Scribner; 496 pages; \$26.99. Bodley Head; £22

SOME PEOPLE have such a hectic existence they give the impression that, in order to fit it all in, they must be paying someone else to do their sleeping for them. One such is Siddhartha Mukherjee. His day job is as a clinical oncologist and professor of that subject at Columbia University. He also writes for the New York Times and the New Yorker. He has, so far, published three books. This is his fourth. And the vignettes in its pages make clear that he still manages to find time for family life. Annoying.

“The Song of the Cell”, like two of its predecessors, “The Emperor of All Maladies” (cancer) and “The Gene” (self-explanatory), is a tour d'horizon of its subject. (Dr Mukherjee's other volume, “The Laws of Medicine”, is a musing on his chosen profession.) “The Song of the Cell” is part history lesson, part biology lesson and part reminder of how science itself actually proceeds—the valleys of silence, as he calls them, where all is busy work with no strong theory to knit everything together, punctuated by moments of insight about what the connecting principles are.

For biology, the overarching connectors are evolutionary theory and cell theory. Evolution is a subject well served by popular literature. Cell theory, which asserts that organisms are made of cells which themselves derive from pre-existing cells, less so. Cells (or, strictly speaking, their walls in a slice of cork) were first identified in the 17th century by Robert Hooke, an early microscopist. He called them that because they reminded him of

monks' dwellings. Cell theory itself did not come about until the 19th century. In this, biology developed the opposite way round from chemistry, where atomic theory guided practitioners for several decades before the physical existence of atoms was proved.

Dr Mukherjee ties the birth of cell theory to a dinner in Berlin in 1837, over which Theodore Schwann, a zoologist, and Matthias Schleiden, a botanist, compared notes about their studies and saw underlying similarities in how the cells of animals and plants were organised and grew. Since then, as he describes, much of biology has been about discovering either how cells work (for they are far more complicated than atoms), or, when they are parts of multicellular organisms rather than being independent organisms in their own right, how they collaborate—or fail to do so in the case of illnesses such as cancer.

He is particularly good at excavating forgotten heroes. Schwann's name may be familiar to some who recognise it from the eponymous cells that insulate the wiring of the peripheral nervous system. Who, though, remembers George Palade, who pretty much invented cell biology's modern incarnation by breaking cells open and centrifuging them to separate their components? Or Walther Flemming, who discovered mitosis, the chromosomal ballet that creates two nuclei out of one during cell division? Or even Karl Landsteiner, whose determination of blood groups laid the foundations for blood transfusion? Yet they were, in their time, the Monets, Turners and Picassos of their field.

Lest the usefulness of all this be forgotten, cases from the author's own career illustrate the consequences of both cellular understanding and the lack of it. The personal comes through in other ways, too. He began as a haematologist, and blood is the medium through which he chooses to teach many of his lessons; he devotes it almost 100 pages, a quarter of the book.

Neurons, meanwhile, have to make do with a couple of dozen pages. Plants do not get much of a look in, either, nor animals not on the list of those used for medical research. Even bacteria, admittedly possessed of cells very different from those of animals and plants, command less than a score of pages.

But that is to quibble. For anyone who wants to understand the building blocks of their own bodies—which everyone surely should—this is an informative and entertaining introduction. ■



生物学

悉达多·穆克吉的新书是对细胞理论的一次概览

他用自己医学生涯中的例子强调了解细胞的重要性【《细胞之歌》书评】

《细胞之歌》，悉达多·穆克吉著。Scribner出版社；496页；26.99美元。Bodley Head出版社；22英镑。

有些人每天忙忙碌碌，日理万机，让人觉得他们能把事情桩桩件件都安排好，肯定是花钱请人替他们睡觉了。悉达多·穆克吉（Siddhartha Mukherjee）就是这样的大忙人。他的主业是哥伦比亚大学的临床肿瘤学家，也是这门学科的教授。他还为《纽约时报》和《纽约客》撰稿。他之前已经出版了三本书。今天介绍的是第四本。书中的小插曲清楚地表明，他还能挤出时间来陪伴家人。真让人恼火。

《细胞之歌》（The Song of the Cell）和之前的两本书《众病之王》（The Emperor of All Maladies，讲的是癌症）及《基因传》（The Gene，显然是讲基因）一样，也是对所述主题的一次概览。（另一部著作《医学的真相》[The Laws of Medicine]是他对自己所选择的职业的深思。）《细胞之歌》既是历史课，也是生物课，同时也提醒读者科学本身实际是如何发展的——他称之为寂静的山谷，大家都忙得不可开交，却没有有什么坚实的理论能把所有研究工作联系起来，只是间或会传出一些发现了连接原则可能是什么的声响。

对于生物学来说，最重要的连接线是进化理论和细胞理论。进化论在通俗读物中频繁出现，细胞理论就没这样的待遇了。细胞论认为生物是由细胞构成的，而细胞本身又来源于已有的细胞。细胞（或者，严格说来是软木塞切片上的细胞壁）是在17世纪由早期显微镜学家罗伯特·胡克（Robert Hooke）首次发现的。之所以起“cell”这个名字是因为它们让胡克想到僧侣住的小房间。细胞理论本身直到19世纪才出现。在这一点上，生物学的发展道路与化学正相反。化学中的原子理论指引了研究人员几十年之后，原子的实际存在才被证实。

穆克吉将细胞理论的诞生与1837年柏林的一次晚宴联系起来。在那次晚宴上，动物学家西奥多·施旺（Theodore Schwann）和植物学家马蒂亚斯·施莱登（Matthias Schleiden）交流了各自的研究，发现动植物细胞的组织和生长方式在根本上有相似性。如他所述，从那以后生物学的大部分研究都在探索细胞如何工作（因为细胞比原子复杂得多），或者当它们是多细胞有机体的组成部分而不是独立有机体时，它们是如何协作的——或者在癌症等疾病情况下它们又为何无法协作了。

他特别擅长挖掘被遗忘的英雄。有些人可能听过施旺这个名字，应该是从包裹周围神经系统中神经纤维轴突的施旺细胞知道的。不过，谁还记得乔治·帕拉德（George Palade）？他打破细胞并离心分离出了细胞组分，几乎创建了现代细胞生物学。还记得瓦尔特·弗莱明（Walther Flemming）吗？他发现了有丝分裂，即在细胞分裂过程中一个细胞核一分为二的染色体“芭蕾”。甚至还有卡尔·兰德斯坦纳（Karl Landsteiner），他对血型的测定为输血奠定了基础，谁还记得他呢？但是，在他们的时代，他们是各自领域里的莫奈、透纳和毕加索。

为了让这些贡献不被遗忘，作者用自己职业生涯中的例子展示了解或不了解细胞带来的结果。他也用其他方式“夹带私货”。他最初是血液学家，在教授许多课程时都用血液学做工具；这部分他写了将近100页，占全书四分之一的篇幅。

与此同时，神经元就只分到三五十页。植物也没有得到太多关注，那些不在医学研究对象名单上的动物也一样。即便是细菌，虽然公认细菌细胞与动植物细胞有很大的不同，作者也就只给了它们十来页。

不过这么说有点吹毛求疵了。对于任何想要了解构成自己身体的基本单位的人来说——每个人当然都该这样做——这是一本翔实又有趣的入门书。





Neanderthal man and woman

DNA grants a glimpse of Neanderthal family life

Work from the lab of Svante Paabo doubles the number of known Neanderthal genomes

FRESH FROM his award a couple of weeks ago of a Nobel prize for his work on the DNA of early human species, including Neanderthals, Svante Paabo (or, more accurately, he and a group of his acolytes) have just published in Nature one of the biggest genetic studies yet of that species.

These Neanderthals lived 50,000 years ago in the Altai mountains of Russia. The remains under study—17 bone and tooth samples belonging to 13 individuals—came from two caves about 100km apart. One, called Chagyrskaya, yielded 11 individuals (three boys, three girls, three men and two women). The other, Okladnikov, yielded two (a boy and a woman). Taken together, this work almost doubles the number of Neanderthal genomes that have been described. It also gives a tantalising glimpse into Neanderthal social lives.

It is extremely unlikely that all of these individuals were contemporaries. But the researchers think they have found both a trio and a pair of relatives. They did this by computing a value called DNA divergence.

DNA divergence compares nuclear genomes by choosing sections of their DNA at random and checking if, for each chosen section, the two genomes match. The more similar the DNA sequences are, the more closely, it can be presumed, the two individuals are related. Applying this approach to the Chagyrskaya remains revealed a father, his daughter and a close maternal relative who probably shared a grandmother with the father. Separately, it matched a young boy to an adult female relative, potentially a cousin, aunt or grandmother.

The individuals in the Okladnikov cave were related closely neither to each other nor to anyone from Chagyrskaya. Yet the researchers found an intriguing connection. The woman's mitochondrial DNA matched that of a man from Chagyrskaya.

Mitochondrial DNA is passed intact from mother to offspring. It is not involved in sexual mixing, so it changes only by the random process of mutation. The lack of mutations that might have distinguished the DNA of the individuals in question from each other suggests not only a common ancestor, but a relatively recent one.

Further analysis showed also that two of the mitochondrial DNA samples from Chagyrskaya were closer to the Okladnikov boy than to any of the other Chagyrskayans. And when the team looked at data on Y-chromosomes, which pass intact from father to son, as well as their mitochondrial data, they were able to draw some tentative conclusions about Neanderthal communities.

If members of a population mate more or less at random with those of the opposite sex, the so-called coalescence time—how far in the past their most recent common ancestor lived—should be the same for mitochondrial (matrilineal) and Y-chromosome (patrilineal) DNA. The researchers found, however, that the average coalescence time for the Y-chromosome was 500 years, while that for the mitochondrial genome was around 5,000 years.

To explain this order-of-magnitude difference, they modelled various possibilities. The one which best fitted the data was that the Neanderthals of the Altai lived in groups of around 20 individuals, with at least 60% of the females in a group having migrated there from elsewhere. The size of such groups is similar to that deduced for Palaeolithic bands of Homo sapiens, which probably had around 25 members.

When dealing with humanity's ancestors and cousins it is easy and tempting to over-interpret the scarce data available—and practitioners of the subject have indeed been guilty of doing this in the past. So these conclusions should be treated with care. But if nothing else, this study shows that the methods which brought Dr Paabo his prize have increased the pool of data available for such speculations in an extraordinary way. ■



尼安德特男女

DNA让人一窥尼安德特人的家庭生活

斯万特·帕博的实验室研究让已知尼安德特人基因组的数量翻了一番【新知】

几周前，斯万特·帕博（Svante Paabo）刚刚凭借对尼安德特人等早期人种的DNA的研究荣获诺贝尔奖。现在，他（或者更准确地说，是他和他的门生）在《自然》杂志上发表了迄今为止对该人种的规模数一数二的基因研究。

这些尼安德特人生活在五万年前的俄罗斯阿尔泰山脉。正在研究的遗骸——属于13个人的17块骨头和牙齿样本——来自两个相距约100公里的洞穴。一个名为Chagyrskaya的洞穴有11人（三个男孩、三个女孩、三个男人，以及两个女人）。另一个名为Okladnikov的洞穴有两人（一个男孩和一个女人）。合在一起，这一成果几乎将已确定的尼安德特人基因组的数量翻了一番。它也让人得以一窥尼安德特人的社会生活，激发了更多的好奇。

所有这些个体都生活在同一时代的可能性极低。但研究人员认为其中有两组有亲缘关系的人，分别包括三人和两人。他们是通过计算DNA序列差异值得出这个结论的。

DNA序列差异需要比较核基因组，方法是随机选择DNA的片段，对比两个所选片段中的基因组是否匹配。DNA序列越相似，就可以推测这两个个体的血缘关系越紧密。将这一方法用于对Chagyrskaya洞穴的遗骸后，发现了一位父亲、他的女儿，以及他们的一位母系近亲，可能与这位父亲是同一个（外）祖母。另外，这一方法也让一个小男孩匹配上了他的一位成年女性亲属，可能是他的堂（表）姐、姑（姨）母或（外）祖母。

Okladnikov洞穴里的男孩和女性没有近亲关系，他们和Chagyrskaya洞穴里的任何人之间也没有。但是研究人员发现了一个很有意思的关联。这名女性的线粒体DNA与Chagyrskaya洞穴里的一名男子的相匹配。

线粒体DNA由母亲完好地传给后代。它不发生遗传重组，所以只通过随机突变发生改变。上述两人的线粒体DNA没有发生使它们变得不同的突变，表明他们不仅有共同的祖先，而且还是相对较近的祖先。

进一步的分析还表明，来自Chagyrskaya的其中两个线粒体DNA样本与Okladnikov男孩的相近度高于Chagyrskaya洞穴里的其他人。通过查看从Y染色体（由父亲完整地传给儿子）的数据，还有线粒体数据，他们得出了一些关于尼安德特人社区的初步结论。

如果一个群体的成员与异性的交配或多或少是随机的，那么所谓的溯祖时间——距离他们最近共同祖先生活的年代的时间——对于线粒体（母系）和Y染色体（父系）DNA来说应该是相同的。但是，研究人员发现，这个群体里Y染色体的平均溯祖时间为500年，而线粒体基因组的平均溯祖时间约为5000年。

为了解释这种数量级的差异，他们模拟了各种可能性。最符合数据的解释是，阿尔泰的尼安德特人以大约20名个体为一个群体生活，其中至少60%的女性从其他地方迁徙而来。这样的群体规模与对旧石器时代智人群体的推断相近，后者可能有大约25个成员。

在研究人类的祖先和表亲时，对手头上的零星数据做过度解释很容易发生，也很有诱惑力——这一领域的研究人员过去的确也犯过这样的错。所以应当谨慎对待这些结论。但这项研究至少表明，让帕博获得诺奖的研究方法以非同寻常的方式扩大了可用于做此类推断的数据池。■



Reality bites

How much trouble is Mark Zuckerberg in?

As Facebook fades, Meta hopes for success in another dimension

IT IS NIGHT-TIME at the Soapstone Comedy Club. In fact, it always is. The club is a space in Horizon Worlds, Meta's flagship metaverse app, where users can watch and perform comedy in virtual reality (VR). "It's hard to do stand-up when you have no legs," quips one performer, gesturing to his hovering avatar, before accidentally dropping the virtual microphone and floating offstage. A night out in VR lacks some of the atmosphere of a real bar, though it does cause authentic dizziness and nausea.

It is almost a year since Mark Zuckerberg announced that his company would change its name from Facebook to Meta, to reflect its commitment to the metaverse and, no doubt, to escape the firm's toxic public image. Many were unsure what the word meant, but with the company's value at a near-all-time high of \$1.1trn, and its core social-network advertising business humming away on the back of a pandemic boom, investors were willing to indulge the experiment.

A year on, things look different. The metaverse on which so much has been staked remains unproven and unpopular. Meanwhile there are signs that both users and advertisers are drifting away from the social networks that pay Meta's bills. Since its rebranding the company's share price has dropped by 60%, destroying more than half a trillion dollars of market value (see chart 1). Forecasts for profits in 2023 have fallen by about 50%, according to data from Bloomberg. Meta's next earnings results, due on October 26th, represent an "existential quarter", says Mark Shmulik of Bernstein, a broker.

What has gone wrong? The sell-off of Meta stock began in February, after the company reported its first-ever drop in daily users of Facebook, its first

and largest social network. After 18 years of uninterrupted growth it lost 1m of them between October and December 2021 (see chart 2). It has since bounced back, adding 39m more, while users of Meta's "family of apps", which includes Instagram and WhatsApp, have kept growing.

But the new users increasingly come from poor countries, and are therefore less valuable to advertisers. Last year Frances Haugen, a whistleblowing former Meta executive, claimed that in Facebook's five most valuable markets, account registrations for under-18s had fallen by a quarter within a year. Meta has hurried out a new short-video product, Reels, to stem the bleeding to TikTok and other new rivals.

As users wobble, so do advertisers. In the second quarter Meta's revenue fell year on year, for the first time in its history (see chart 3). Inflation, interest rates and war all played a part. But the ad business has been permanently changed by Apple's new rules. These make it harder for iPhone apps to track users' online activity, which in turn makes it harder to serve them relevant ads and see whether they work. Meta has said that Apple's changes will cost it \$10bn this year in forgone revenue. Companies are shifting their advertising to what admen call the bottom of the funnel: points at which the consumer is close to a purchase (Amazon, which serves ads to customers based on what they have just searched for, has been a big beneficiary).

As it faces these market headwinds Meta is also being harried by regulators. America's Federal Trade Commission (FTC) is suing Facebook for abusing its supposed monopoly in social networking, an accusation which seems increasingly eccentric given recent advances by TikTok and other rivals. In July the FTC pounced on Meta's proposed acquisition of Within, a maker of VR fitness apps. And on October 18th British regulators ordered Meta to undo its purchase of Giphy, a maker of animated images that it had bought in 2020.

Meta is better equipped than many of its rivals to overcome these obstacles. Reels already accounts for more than 20% of time spent on Instagram, and is making more money than Instagram's successful Stories feature did at the same stage of its introduction, the company says. Heavy investment in artificial intelligence (AI) is helping Meta develop "probabilistic" ad models to replace the signal that was lost with Apple's changes. Advantage+, a recent Meta ad product, uses AI to help advertisers develop and place ads.

A trickier ad business serves to widen Meta's competitive moat, points out Mr Shmulik: smaller rivals like Snap, whose share price has fallen by nearly 90% in the past 12 months, are the real casualties. Still, Meta's advertising franchise has probably been permanently impaired. And the company is scrambling to rebuild its ad business without the architect of its previous one, Sheryl Sandberg, who left the company in September.

All this would be enough to give investors jitters. The fact that Meta is simultaneously making a colossal bet on the metaverse threatens to test their faith to breaking point. Reality Labs, the company's metaverse division, has so far run up losses of \$27bn. Meta has sold more than 17m Quest 2 VR headsets, estimates IDC, a data company, mostly at or below cost. It has also been on a hiring spree, last year announcing 10,000 new metaverse jobs in Europe. The pace of hardware development continues: on October 11th Meta unveiled a more advanced Quest Pro headset, and Mr Zuckerberg showed off prototype hardware including a wrist-worn neural-input device. A Quest 3 and Quest Pro 2 are already in the works.

When—or whether—the metaverse will take off remains unclear. The Quest's main use so far is gaming. Fitness is a growing niche, though Meta's progress in that area could stall if its purchase of Within is blocked. The Quest Pro is aimed at businesses; on its launch last month Meta announced a partnership with Microsoft, which will provide VR versions of apps like Teams and Office. A "Quest for Business" subscription will be available next

year.

But the social uses of VR, about which Mr Zuckerberg is most enthusiastic and where Meta should have the greatest advantage, remain unpopular. In February Meta reported that just 300,000 people had used Horizon Worlds; the firm has said nothing since. On October 16th the Wall Street Journal reported that, according to internal Meta documents, the number of regular users had declined since the spring. A leaked internal memo suggested that even company employees were having to be cajoled to use it (“If we don’t love it, how can we expect our users to love it?”).

Mr Zuckerberg is hardly the only one who sees potential in VR. In the first half of next year Apple is expected to release its debut headset, and Sony will launch its latest gaming-focused goggles for its PlayStation console. If headsets do become the new PCs, as Mr Zuckerberg has predicted, Meta will enjoy a considerable first-mover advantage. The Quest 2 accounted for 88% of global VR-headset sales in the first half of this year, IDC reckons. The Quest Pro is the most advanced set of VR glasses around. Meta’s hiring binge means that it has much of the top VR talent, says Jitesh Ubrani of IDC. If Meta can control and tax a successful VR platform, as Apple and Google control their mobile operating systems, it will own a gold mine (Meta already skims off as much as 47.5% from Horizon Worlds purchases).

The question is timing. Meta’s unusual structure gives Mr Zuckerberg total control. The firm’s board proved to be ineffective at dealing with Facebook’s scandals over privacy and misinformation. Now, rather than urge caution, it has allowed a flawed chief executive to gamble billions on the metaverse. In May Mr Zuckerberg admitted as much when he told Protocol, a news site: “If people invest in our company, we want to be profitable for them...But I also feel a responsibility to go for it...[Meta] is a controlled company, so I can make more of these decisions than most companies would.”

| *Antisocial behaviour*

Yet the more Meta's core business wobbles, the less investors will be willing to give Mr Zuckerberg's metaverse plans the benefit of the doubt. A company can only spend that much on a new idea if someone is prepared to fund it. They might be if "your core profitability from your core business is on solid footing", says Mr Shmulik. That is Meta's difficulty. "The core isn't on a solid footing at the moment."

To calm investors' nerves, Meta is reining in its spending a little. It expects its total expenses this year to be about \$7.5bn lower than it forecast at the end of 2021. It has scrapped some projects, including a smart watch that was in development, and bumped up the price of the Quest 2 by \$100. And it expects to reduce its headcount.

Meta executives compare the company's predicament now to ten years ago, when it was managing the transition of its social network to mobile. Shifting a billion Facebook users from desktop to phone was no mean feat, made harder by the fact that Mr Zuckerberg was late to spot the importance of mobile. That experience may have influenced his approach to the metaverse. Meta's new VR technology, he said on October 11th, was for those "who'd rather be early than fashionably late". The risk, as investors grow impatient, is that this time Meta has made its move too soon. ■



现实弄人

扎克伯格的麻烦有多大？

Facebook渐落寞，Meta希望在另一个维度上取得成功

这里是皂石喜剧俱乐部（Soapstone Comedy Club），时间是晚上。事实上，这里总是晚上。这个俱乐部是Meta的元宇宙旗舰应用Horizon Worlds中的一个空间，用户可以在虚拟现实（VR）中观看和表演喜剧。“没有腿不好演脱口秀。”一位表演者指着自己飘浮在半空的化身打趣道，然后他不小心弄掉了虚拟麦克风，飘到了舞台之外。在VR中夜出玩耍缺乏真正的酒吧的氛围，尽管它确实会引起真实的头晕恶心。

将近一年前，马克·扎克伯格宣布Facebook更名为Meta，以表达公司下注元宇宙的决心，这无疑也是为了摆脱它非常负面的公众形象。许多人不确定Meta这个词是什么意思，但当时这家公司市值高达1.1万亿美元，接近历史高点，而且其核心的社交网络广告业务在疫情之下蓬勃发展，因此投资者愿意任由扎克伯格搞这个实验。

一年过去了，局面今非昔比。押下重注的元宇宙仍未能证明自己，也没有流行起来。与此同时，有迹象表明用户和广告主都在逐渐离开为Meta买单的社交网络。自更名以来，公司股价已下跌60%，市值蒸发超过5千亿美元（见图表1）。彭博的数据显示，对2023年的利润预测下降了约50%。经纪公司盛博的马克·舒姆里克（Mark Shmulik）表示，Meta于10月26日发布的第三季度业绩将是一个“攸关存亡之季”。

出了什么问题呢？Meta的股票被抛售始于今年2月，当时公司公布它的第一个也是最大的社交网络Facebook的日用户数首次出现下降。在此前18年里Facebook的用户数不间断增长，但在2021年10月至12月间流失了100万人（见图表2）。自那以后，用户数又开始反弹，增加了3900万，而Meta“应用家族”（包括Instagram和WhatsApp）的用户数一直保持增长。

但新用户越来越多地来自于贫穷国家，因此对广告主来说价值不太高。去

年，揭发公司内幕的前高管弗朗西斯·豪根（Frances Haugen）称，在Facebook最有价值的五个市场中，18岁以下用户的账户注册数量在一年内减少了四分之一。为阻止用户流失到TikTok和其他新竞争对手，Meta匆忙推出了一款新的短视频产品Reels。

一旦用户开始动摇，广告主也跟着动。今年第二季度，Meta的收入出现了历史首次同比下降（见图表3）。通胀、利率和战争都有一定影响。但苹果的隐私新规已经永久改变了广告业务。这些新规让iPhone的应用更难跟踪用户的在线活动，也就更难对他们精准投放广告并查看实际效果。Meta曾表示，苹果的新规则今年会让它损失100亿美元的收入。众多公司正在将它们的广告转移到广告行业所说的漏斗底部，即消费者即将产生消费行为的点（根据用户刚刚搜索过的内容向他们推送广告的亚马逊受益很大）。

除了要面对这些市场不利因素，Meta还要应付监管机构的烦扰。美国联邦贸易委员会（FTC）正在对Facebook发起诉讼，指控它滥用在社交网络上所谓的垄断地位——鉴于TikTok等竞争对手近年来的进展，这项指控日益显得古怪。7月，FTC突然拿Meta收购VR健身应用开发商Within一事发难。10月18日，英国的监管机构下令Meta出售它于2020年收购的动图搜索平台Giphy。

与许多竞争对手相比，Meta更有实力克服这些障碍。该公司表示，花在Reels上的时间已占Instagram使用时间的20%以上，并且它带来的盈利也高于Instagram获得成功的Stories在发布后同一阶段的盈利。对人工智能（AI）的大量投资正在帮助Meta开发“概率”广告模型，以取代因苹果的规则变化而无法获得的导向信息。Advantage+是Meta最近推出的广告产品，用AI帮助广告主开发和投放广告。

舒姆里克指出，广告生意变得更难做有助于拓宽Meta的护城河，那些规模较小的竞争对手才真正受到重创，比如Snap的股价在过去12个月中下跌了近90%。但无论如何，Meta的广告业务很可能已经永久受损。缔造了它的广告业务的谢丽尔·桑德伯格（Sheryl Sandberg）在9月离职，公司目前

正在匆忙重构这个部门。

所有这些都足以令投资者不安，而与此同时Meta又对元宇宙押下重注，这可能会极度考验投资者的信心。该公司的元宇宙部门Reality Labs迄今已亏损了270亿美元。据数据公司IDC估计，Meta已售出超过1700万台Quest 2 VR头显，大部分以成本价或低于成本价售出。它也一直在大举招聘，去年宣布将在欧洲新增一万个元宇宙相关工作岗位。硬件开发依然按部就班地推进着。10月11日，Meta推出了更先进的Quest Pro头显，扎克伯格展示了包括腕戴式神经输入设备的原型机。Quest 3和Quest Pro 2已经在开发中。

元宇宙何时或能否大行其道仍不清楚。到目前为止，Quest的主要用途是游戏。健身是一个不断增长的利基市场，但如果Meta对Within的收购受阻，它在该领域的进展可能会停滞不前。Quest Pro面向企业用户。Meta在10月发布它时宣布与微软建立合作伙伴关系，后者将提供Teams和Office等应用的VR版本。明年将推出“Quest for Business”订阅服务。

但是，扎克伯格最热衷的VR社交仍然不受欢迎，这也是Meta应该最有优势的领域。2月，Meta公布的数据显示只有30万人用过Horizon Worlds。从那以后，该公司就再没有公布过相关数据。10月16日，《华尔街日报》报道称，根据Meta内部文件，自春季以来普通用户数量有所下降。一份遭泄露的内部备忘录表明，即使公司自家员工也得连哄带骗地才会去用它（“我们自己都不爱用，怎么能指望用户喜欢？”）。

扎克伯格并不是唯一一个看到VR潜力的人。明年上半年，苹果预计将发布其首款VR头显，索尼将为其PlayStation游戏机推出最新的游戏专用眼镜。如果VR头显真得能像扎克伯格预测的那样成为新的个人电脑，Meta将享有相当大的先发优势。IDC估计，今年上半年，Quest 2占到全球VR头显销量的88%。Quest Pro是目前市面上最先进的VR眼镜。IDC的吉特什·乌布拉尼（Jitesh Ubrani）表示，Meta大举招聘意味着它吸收了大部分顶尖VR人才。苹果和谷歌都控制着它们的移动操作系统并从中抽成，如果Meta在一个成功的VR平台做到这一点，它将坐拥一座金矿（Meta目前对

Horizon Worlds中的交易抽成比例高达47.5%)。

现在的问题是时机。Meta不同寻常的公司结构让扎克伯格拥有完全的控制权。事实证明，该公司的董事会对Facebook的隐私和虚假信息问题应对不力。现在，它不但没有敦促谨慎行事，反而让一位已经显现问题的首席执行官把数以十亿计美元赌在元宇宙上。5月，扎克伯格在接受新闻网站Protocol采访时也承认了这一点：“如果投资者投资了我们公司，我们当然希望为他们带来利润.....但我也觉得有责任放手一搏..... (Meta) 是一家受控公司，所以比起大多数公司，我可以做出更多这类决定。”

| 反社交行为

然而，Meta的核心业务越不稳定，投资者就会越不愿意给扎克伯格的元宇宙计划试试看的机。一家公司可以在一个新点子上投入，只要有人愿意为此投资。人们可能会愿意，如果“你的核心业务带来的核心盈利能力非常稳固”，舒姆里克说。这就是Meta的问题所在。“它的核心目前并不稳。”

为了平息投资者的紧张情绪，Meta稍微节制了支出。它预计今年的总支出将比2021年底的预测减少约75亿美元。它已经取消了一些项目，包括正在开发的智能手表，并将Quest 2的价格提高了100美元，而且预计会裁员。

Meta的高管将公司现在的困境与十年前的相提并论，当时公司正在将其社交网络平台过渡到移动设备端。把十亿Facebook用户从桌面电脑转移到手机上绝非易事，扎克伯格迟迟没有意识到移动端的重要性让这一过程变得更加困难。那次经历可能影响了他对元宇宙的态度。他在10月11日表示，Meta的新VR技术是准备给那些“赶早不赶晚”的人。随着投资者越来越不耐烦，Meta这一次的风险是它行动得太早了。■



Plugging away

Chinese marques try to make inroads into Western markets

Second time lucky?

THE FAILURE of the first serious attempt by China's carmakers to conquer European markets, around 15 years ago, was self-inflicted. Their cars were terrible. The shabby quality of Brilliance's "BS" range (no joke) was matched with looks that scarcely merited the word "design". Since then the Chinese car industry has become the world's biggest and its products have improved immeasurably. It churns out more electric vehicles (EVs) than any other country, and many are anything but BS. It is also an EV-battery superpower.

EV-friendly Europe is again in China's sights. Norway, where generous tax breaks mean that four out of five cars sold are fully electric, has served as a bridgehead. Now Chinese firms are launching a wider assault on the continent. In Berlin on October 7th Nio, a Tesla wannabe, showed off three new models. At the Paris motor show, which opens on October 17th, BYD and Great Wall Motors (GWM) will give more details of their plans for Europe.

Rich subsidies have created a vast home market for Chinese EVs, encouraging established firms and startups alike. BYD's plug-in cars (some are hybrids rather than full EVs) now outsell Teslas worldwide. Subsidies contingent on local production have deterred imports, obliging firms such as Tesla to set up in China, strengthening domestic supply chains. A ban on foreign battery-makers has made China their predominant manufacturer. And cheap money supplied by central and local government has given Chinese firms access to buckets of capital.

Scale at home has helped Chinese firms keep costs low. Their cheaper EVs are now filling the European market ill-served by Western carmakers,

which have focused on higher-end rides. Chinese brands already accounted for nearly one in 20 EVs sold in western Europe in the first eight months of 2022, according to Schmidt Automotive, a consultancy. Around half of those sales, some 22,000 cars in 14 countries, were budget EVs from MG, a division of SAIC, a Chinese state-owned giant. GWM will soon aim at the same segment with its “Funky Cat” EV, from its Ora marque.

The Chinese are trying to establish trusted brands, not always from scratch. Geely has owned Sweden’s Volvo since 2010 and an affiliated investment vehicle owns 10% of Mercedes-Benz. In September Geely bought 8% of Aston Martin, a struggling British sports-car firm. Its experience of making cars to European standards may be why its Polestar EVs, part of Volvo until 2017, sell nearly as well in Europe as MGs do. The U5 from Aways, a five-year-old startup, was a finalist this year in the prestigious European Car of the Year contest. BYD’s recent deal with Sixt, a German car-rental firm, to supply it with 100,000 EVs by 2028 may help to familiarise motorists with its cars, including a small, cheap SUV.

Competition will be tougher in the more lucrative premium segment, observes Matthias Schmidt of Schmidt Automotive. BYD’s larger models cost about as much as similar Western cars. Fancier Chinese brands such as Nio, Xpeng and GWM’s Wey may have missed their chance as Germany’s premium carmakers belatedly roll out more upmarket EVs. And if they do too well, one industry boss notes, their European rivals can always plead for more protection. As anti-Chinese sentiment grows in the West, politicians are in the mood to grant it. ■



锲而不舍

中国汽车品牌试图攻入西方市场

第二次会有好运吗？

大约15年前，中国车厂第一次真正出征欧洲市场告败，那一次是自讨苦吃。它们的车太糟糕了。华晨汽车的“BS”系列（就叫这个名字）质量低劣，外型也没什么“设计”可言。自那之后，中国的汽车产业已扩张至世界第一大规模，其产品相比当年也已有了天壤之别。中国生产的电动汽车比任何其他国家都多，其中许多车都绝不是瞎胡闹的。同时中国也已是动力电池的超级大国。

青睐电动汽车的欧洲再次进入中国的视线。挪威有着慷慨的优惠税收政策，每售出五辆车就有四辆是纯电动，一直以来充当了进军欧洲市场的桥头堡。现在，中国企业正向欧洲大陆发起更广泛的攻势。10月7日，对标特斯拉的蔚来汽车在柏林展出了三款新车型。在10月17日开幕的巴黎车展上，比亚迪和长城汽车将公布各自欧洲计划的更多详情。

丰厚的补贴为中国的电动汽车创造了巨大的国内市场，激励了传统车厂和造车新势力。比亚迪的插电式汽车（其中一些属于混动而非纯电）如今在全球的销量已经超过了特斯拉。能否获得补贴要看是否在当地生产，这遏制了进口，也迫使特斯拉等公司在中国建厂，加强了国内供应链。一项对外国电池制造商的禁令使中国成了电池的主要产地。中央和地方政府提供的廉价资金也让中国企业获得了大量资本。

国内市场的规模效应帮助中国企业维持了低成本。由于西方车厂一直专注于高端车型，中国的低价电动车正在填补欧洲市场的空缺。根据咨询公司施密特汽车研究（Schmidt Automotive）的数据，在今年头八个月里，中国品牌已占到西欧电动车销量的近二十分之一。它们在该地区14个国家售出了约2.2万辆车，其中有一半左右是国有巨头上汽集团旗下品牌名爵生产经济型电动车。长城汽车很快也将带着它的欧拉品牌下的“好猫”电动车进军这一细分市场。

中国人正试图建立可信的品牌，但并非完全从零开始。吉利在2010年就收购了瑞典的沃尔沃，并通过一个附属投资公司持有梅赛德斯-奔驰10%的股份。它在今年9月收购了陷入困境的英国跑车公司阿斯顿马丁8%的股份。

或许正是由于有了按欧洲标准生产汽车的经验，吉利旗下的极星

（Polestar）电动汽车（2017年之前属于沃尔沃）在欧洲卖得几乎和名爵一样好。创立五年的爱驰汽车生产的U5车型今年入围了著名的欧洲年度风云车大赛（European Car of the Year）评选。比亚迪最近与德国汽车租赁公司Sixt达成协议，从现在到2028年向其供应10万辆电动车，这可能有助于驾车者熟悉比亚迪的汽车，包括一款小型低价SUV。

施密特汽车咨询（Schmidt Automotive）的马蒂亚斯·施密特（Matthias Schmidt）认为，在利润更丰厚的高端市场，竞争将更加激烈。比亚迪较大车型的售价与西方的类似车型差不多。随着德国的豪华车厂终于开始推出更多高端电动车，蔚来、小鹏和长城魏牌等更高档的中国品牌可能已经错失了机会。一位业内老板指出，如果中国车厂表现得再好，其欧洲竞争对手总是可以恳求加大行业保护。随着西方的反华情绪增长，政客也会乐于顺应这种请求。 ■



A new look

Fashion gets a modern makeover

A \$700bn industry flirts with new materials, new countries—and new clients

PARIS FASHION WEEK always makes heads turn. Two events that took place during this year's extravaganza, which concluded on October 4th, made it dizzying. On September 29th a crocodile-skin Hermès handbag became the priciest ever to be auctioned at Sotheby's. It was the apotheosis of old-school luxury: timeless, leather-bound and, at €352,800 (\$346,800), eye-poppingly expensive. The next day Coperni, a French fashion house barely ten years old, showed off luxury's whizzier side by spraying a nearly nude supermodel with an ingenious and animal-friendly material that coalesced into a snug white number (see picture).

This tug of war between tradition and novelty is nothing new in luxury fashion. It is now becoming true of its makers' business models, too. A post-pandemic rebound in sales of personal luxury goods, to nearly €300bn (see chart 1), conceals rising volatility within the industry. Investors who used to treat large luxury groups such as LVMH, Hermès and Kering as pretty much of a piece are now differentiating between them (see chart 2) as they adapt—or not—to the new tastes of new shoppers in new places. In the process, an industry with a market value of some \$700bn is getting a new look.

The first change in the luxury market is geographic. Last century fashion houses sailed the winds of globalisation from Europe and America to Japan and then, in the past decade, China. As the Chinese economy slows and the Communist Party turns the screws on the ultra-rich, firms are looking elsewhere for growth opportunities, particularly to the oil-soaked Persian Gulf, whose well-heeled shoppers are growing richer on the back of high fossil-fuel prices. They are happy to splurge some of that wealth on fancy

fashion—and are becoming more adventurous in their purchases. This year Loro Piana, an LVMH label, collaborated with an Emirati artist to create a special Ramadan collection for its Middle Eastern shops.

The Gulf's luxury hub, Dubai, may also be the world's last true entrepot, welcoming of anyone from anywhere, as long as their pockets are deep. The flagship shop in Dubai of Louis Vuitton, LVMH's leading brand, is popular with Russian shoppers, who for reasons of geopolitics are finding it harder to spend their cash in London, Milan, Paris or New York.

The luxury groups are eyeing other underexplored places, from Nigeria and South Africa to India and Indonesia, albeit tentatively for now. In a more profound shift, they are increasingly thinking of markets in terms of cities rather than countries, says Anita Balchandani of McKinsey, a consultancy. In March Gucci (owned by Kering) opened a boutique in Austin, full of rich techies who during the pandemic left nannyish California for less locked-down, lower-tax Texas. In December Louis Vuitton opened a menswear shop in Miami, a city popular with crypto bros. As wealthy Chinese were confined to their home cities by their government's strict covid-19 policies, luxury brands doubled down on outlets in second-tier places such as Chengdu and Nanjing.

Regardless of where they live and shop, buyers are getting younger—a second change facing pedlars of poshness. Between 2019 and 2021 Generation Z, those born between 1997 and 2012, increased its share of global spending on bling from 8% to 17%—much faster than mere generational turnover would imply. Together with Millennials (born in 1981-96), it already accounts more than half of luxury purchases. Bain, another consultancy, expects an increase to three-quarters by 2025.

The rejuvenation of its clientele has far-reaching consequences for the industry, for the young have different ideas about what makes something

luxury. Long-established brands which, like Hermès, stress craftsmanship and heritage have to think about attracting shoppers who care more about self-expression and selfies.

This is leading labels to redefine the role of the creative director. The position has always been critically important to fashion houses. But whereas its occupants used primarily to act as guardians of a brand's image, now they are artistic visionaries with the freedom to redefine it. Alessandro Michele, Gucci's creative director since 2015, has made the 101-year-old label synonymous with his signature animal and jungle motifs. Ideally directors come with a cult following, like Maximilian Davis, a 26-year-old black designer who was appointed to the job at Salvatore Ferragamo in March (in an attempt to modernise, the brand has dropped the eponymous founder's first name from the logo). Brands are also looking for talent beyond couturiers. Virgil Abloh, who until his death last year was Louis Vuitton's creative director for its men's collections, started out designing streetwear.

The creative directors, in turn, are helping redefine what counts as luxury, starting with materials. Fur is out; Kering announced a ban from all its brands last year. Synthetic alternatives are in, even if not all are as high-tech as Coperni's spray-on dress. Stella McCartney, a self-styled vegetarian designer, makes bags from fabric derived from mushrooms rather than leather. In 2019 Prada launched a collection made of yarn recycled from waste, with which it plans to replace all its petroleum-based nylon. The same year Chanel invested in a biotech company developing synthetic silk. All this allows labels to present themselves as environmentally sustainable, a selling point with the Gen-Zs.

Besides new materials, luxury is embracing new styles. This summer Gucci launched a collaboration with Adidas, a mass-market sportswear brand. The collection includes trainers, tracksuits and, lest someone worry about

things getting too downmarket, a reassuringly lavish \$17,500 dress. Citigroup, a bank, estimates that Balenciaga, long a resolutely haute-couture brand (also part of Kering), now derives 15-20% of sales from sneakers.

To rope in aspirational shoppers, labels are offering smaller items at correspondingly lower prices. Jacquemus, a fast-growing independent brand, is selling tiny bags; Prada, an Italian house, key rings; and Kering's Bottega Veneta, credit-card holders. Shopping assistants at (Prada-owned) Miu Miu report strong sales of \$200 hair clips, hardly cheap but a steal next to the label's \$2,000-plus dresses.

All this creative and commercial commotion is unnatural for the luxury industry, which "doesn't like radical changes", as Thomas Chauvet of Citigroup points out. The risk of missteps is high. Investments in places like Cape Town, Jakarta, Lagos and Mumbai, or even Austin and Miami, may take years to bear fruit—and they may never catch up with Beijing and Shanghai. To young ears attuned to the slightest hint of greenwashing, sustainability talk can sound rich coming from companies whose products are by definition never a necessity (and which used to incinerate unsold goods rather than discount them and cheapen the brand).

Most important, attracting a new generation of shoppers before their prime earning (and spending) years with lower-cost little luxuries may put off the core super-rich customers, who still covet exclusivity above all. As one luxury chief executive sums it up, products ultimately need to be "more precious, more sophisticated", so that you can sell fewer at higher prices. "That's the equation of luxury." This much hasn't changed. ■



新造型

时尚业的摩登大变身

一个7000亿美元的行业正在探索新材料和新地区市场，还有新客户

巴黎时装周总是让人目不暇接。今年的盛会于10月4日结束，期间有两件事令人目眩神迷。9月29日，一只鳄鱼皮爱马仕手袋拍出了苏富比同类拍品的史上最高价。它是老派奢侈品的典范：永不过时，皮革制作，贵得令人瞠目（35.28万欧元，合34.68万美元）。次日，成立快10年的法国时装品牌Coperni展示了奢侈品更炫酷的一面，在一名近乎全裸的超模身上喷上一种新颖的动物友好型材料，凝结成一件白色贴身長裙（见图）。

这种传统与新奇之间的拉锯战在奢侈品时尚中毫不新鲜，现在也开始在其制造商的商业模式中上演。疫情后期个人奢侈品销售额反弹至接近3000亿欧元（见图表1），掩盖了行业内不断加剧的波动性。过去，投资者差不多都把大型奢侈品集团如LVMH、爱马仕和开云（Kering）视为一个整体，现在，随着它们做出调整以迎合（或坚持不迎合）新地方新顾客的新偏好，他们开始区分看待这些集团（见图表2）。在这个过程中，一个市值约7000亿美元的行业正在摆出新造型。

奢侈品市场的第一个变化是地理布局上的。上个世纪，时装公司乘着全球化的东风，从欧洲和美国来到日本，过去十年又来到中国。随着中国经济放缓以及共产党收紧了对超级富豪的管束，这些企业开始到其他地方寻找增长机会，特别是盛产石油的波斯湾，那里的富裕购物者因化石燃料价格高企而获益，变得越发富有。他们很乐意把部分财富挥霍在时尚奢侈品上，在买东西时也变得更加大胆。今年，LVMH旗下品牌诺悠翩雅（Loro Piana）与一位阿联酋艺术家合作，为它的中东店铺设计了一个特别的斋月系列。

波斯湾的奢侈品中心迪拜可能也是世界上最后一个真正的转口港，它欢迎来自任何地方的任何人，只要他们的荷包够鼓。LVMH旗下顶尖品牌路易威登在迪拜的旗舰店很受俄罗斯人欢迎，由于地缘政治的原因，他们要在

伦敦、米兰、巴黎或纽约把钱花出去变得更难了。

奢侈品集团正把目光投向其他尚未充分开发的地区——从尼日利亚和南非到印度和印尼，尽管目前的行动还只是试探性的。咨询公司麦肯锡的阿妮塔·巴尔钱达尼（Anita Balchandani）说，在一场更深刻的转变中，它们越来越多地从城市而不是国家的层面考虑市场。3月，开云旗下的古驰在奥斯汀开了一家精品店，在里头打转的全是富有的技术宅，他们在疫情期间离开了紧张兮兮的加州，去了不那么爱封城、税收也更低的得克萨斯。去年12月，路易威登在深受“加密兄弟”喜爱的迈阿密开了一家男装店。由于中国政府严格的防疫政策，中国的富人离不开所在城市，奢侈品牌便在成都和南京等二线城市的门店上加倍投入。

不管顾客住在哪里、在哪里购物，他们的年龄层都越来越低——这是时髦贩卖者们面临的第二个变化。在2019年至2021年间，Z世代（出生于1997年至2012年间）为全球奢侈品支出贡献的份额从8%增加到17%——速度远远快过单是代际更替能解释的程度。他们和千禧一代（出生于1981年至1996年间）的合并份额已经达到一半以上。另一家咨询公司贝恩预计，到2025年这一占比将增至四分之三。

顾客群年轻化对于这个行业影响深远，因为年轻人对奢侈品的定义有所不同。像爱马仕这样强调手工艺和传承的历史悠久的品牌不得不思考如何能吸引那些更在意自我表达和自拍照的顾客。

这正促使一线品牌们重新定义创意总监这一角色。这个职位对时装公司来说一直都至关重要。但是，坐在这个位置的人过去主要是充当一个品牌形象的守护者，而现在他们要展现艺术上的远见卓识，自由地重新定义品牌形象。亚力山卓·米开理（Alessandro Michele）自2015年起担任古驰的创意总监，已经让他标志性的动物和丛林设计主题与这个101年历史的品牌融为一体。创意总监们最好能有一群狂热的追随者，比如26岁的黑人设计师马克西米利安·戴维斯（Maximilian Davis），他于今年3月被任命为菲拉格慕（Salvatore Ferragamo）的创意总监（为与时俱进，该品牌现在只在品牌图标中保留了同名创始人的姓氏）。品牌也在寻找高级时装设计师

以外的人才。维吉尔·阿布洛（Virgil Abloh）在去年去世前担任路易威登男装系列的创意总监，他以设计街头服饰起家。

创意总监们反过来又在帮助重新定义奢侈品。先从材料开始。皮草不流行了，开云去年宣布禁止旗下所有品牌销售动物皮草。合成材料织物开始风行，即使不都像Coperni的喷绘裙那样高科技。自称素食主义设计师的斯特拉·麦卡特尼（Stella McCartney）用蘑菇而非皮革制成的材料制作包袋。2019年，普拉达推出了一个系列，所用的纱线来自回收废弃物，它计划用这种纱线取代自己所有的基于石油的尼龙。同年，香奈儿投资了一家开发合成丝绸的生物技术公司。这一切让品牌能够展现自己的环境可持续性，这在Z世代那里是个卖点。

除了新材料，奢侈品也在拥抱新风格。今年夏天，古驰与大众市场运动服饰品牌阿迪达斯推出了一个联名系列，其中有运动鞋、运动服，还有一款售价17,500美元的礼服——贵得叫一些人放心古驰还没有把自己搞得太掉价。花旗银行估计，巴黎世家（长期以来都是坚定不移的高定品牌，同样归属开云集团）现在有15%到20%的销售额来自运动鞋。

为了笼络蠢蠢欲动的年轻顾客，各品牌开始提供较小巧的商品，售价也相应更低。快速发展的独立品牌Jacquemus销售超迷你小包；意大利品牌普拉达卖钥匙圈；开云的葆蝶家（Bottega Veneta）卖信用卡套。普拉达旗下的缪缪（Miu Miu）的导购报告称，200美元的发夹销售火爆。这个价格并不便宜，但和2000多美元的衣服放在一起就跟白捡的一样了。

正如花旗集团的托马斯·肖韦（Thomas Chauvet）所指出的，所有这些创意和商业上的骚动对奢侈品行业来说并不是自然而然的，毕竟这个行业“不喜欢激进的变革”。行差踏错的风险很高。在开普敦、雅加达、拉各斯、孟买甚至奥斯汀和迈阿密等地的投资可能需要好些年才能开花结果，而且可能永远也赶不上北京和上海。再轻微的疑似“漂绿”的行为也逃不过年轻人的眼睛，他们可能会觉得奢侈品公司大谈可持续发展很可笑，毕竟它们生产的东西不消说从来都不是必需品（而且它们过去宁可把未售出的库存一把火烧掉也不愿打折出售，以免拉低了品牌价值）。

最重要的是，用价格较低的小件奢侈品吸引尚未迎来赚钱（和花钱）黄金期的年轻一代可能会让超级富豪这个核心顾客群不悦，他们仍追求独享性甚于一切。正如一位奢侈品公司首席执行官总结的那样，产品最终需要做到“更珍贵、更精妙”，这样你才能把更少的产品卖出更高的价格。“这就是奢侈品的等式。”这一点从未改变。 ■



Bartleby

When bosses walk in employees' shoes

It is hard for managers to understand what life is like for staff. But not impossible

ANY MANAGER worth their salt knows the value of spending time “walking in their customers’ shoes”. There are many ways to do it. You can observe customers in their natural habitat. Pernod Ricard’s boss recently told Bloomberg, a news service, about his habit of bar-hopping in order to see what people want to drink. Such research is a lot less fun if your company makes soap dispensers for public toilets but the same principle applies.

You can be a customer yourself, buying your company’s products, ringing your own helplines and enduring the same teeth-grinding muzak. Or you can hear from your customers directly. Jeremy Hunt, who has just been appointed Britain’s finance minister but was once its longest-serving health secretary, started each day in that job by reading a letter of complaint from a patient or their family, and writing back to each correspondent personally. If you cancel one internal meeting a week and use that time to hear from customers instead, you will come out ahead on the trade.

This idea does not apply only to customers. It can also be useful inside the organisation. Walking in employees’ shoes is a way for bosses to understand what impedes productivity, what saps morale and what makes workers feel valued. A sense of affinity can come from living in the same community as other members of staff. Recent research found that CEOs in Denmark who lived within 5km of their offices seemed to foster better work environments than those who lived farther away. But short of moving house, how else can managers get inside workers’ heads?

Even if a boss genuinely wants to hear the unvarnished truth, employees may not be comfortable delivering it. Anonymous surveys can help

encourage honesty, as can exit interviews, but even in these settings, workers may temper their views. Reviews on sites like Glassdoor can be brutal, but the motives of the people posting them are not always transparent. Corporate-messaging apps like Slack can provide a partial window into how some teams are getting on, but surveillance is not a form of empathy. And none of this is the same as knowing what it is actually like to be an employee.

It is very hard for managers to replicate the experiences of normal employees. Rooms will magically become available if the boss asks for one; everyone else has to roam around the building like wildebeest that have become separated from the herd. Managers do not have to remind people of their names. They are less likely to suffer some of the common feelings that undermine workers' enthusiasm for their jobs: rare is the boss who feels overlooked or underappreciated. And they are also much less likely than employees to encounter incivility from colleagues.

One option is to appear on "Undercover Boss", an entertaining reality-TV show in which executives put on preposterous disguises, work in their own organisations and discover what life is really like for their workers. If you go down this route you will learn a lot, but you will have to admit to an audience of millions that you have absolutely no idea what is going on in your own organisation. (A less involved option is not to bother with the cameras and to wear your own home-made disguise in the office, though there is a risk your moustache will fall off at a pivotal moment.)

Even without disguises it is good for managers to spend time doing the same work as their underlings. (It is also good for them to stop referring to people as underlings.) Airlines and retailers have run schemes that involve executives working in front-line roles in airports and on shopfloors. DoorDash, a delivery app, has a programme called WeDash that requires salaried employees to make regular drop-offs. And bosses can do things for

themselves that people without assistants must navigate alone. Filling out expense forms is a chore: everyone should have to do their own, at least occasionally. By default bosses should fly in the same airline class as their colleagues do. And so on.

If managers can learn a few things by walking in employees' shoes, there is also value in workers thinking about what life is like as a boss. It is not all business-class travel and people agreeing with you. Imagine getting in a lift and conversation around you always dying. Imagine being grumbled about all the time, or knowing that your absence causes a general lightening of the mood. Imagine not being able to kick a difficult decision upstairs. The boss wears much nicer shoes but they can still pinch. ■



巴托比

当老板站在员工的角度想

管理者不容易理解员工的处境，但并非全不可能

任何称职的管理者都知道花时间“站在客户的角度思考”的价值。做到这一点有不少办法。你可以在顾客处于自然状态时观察他们。法国酒业巨头保乐力加（Pernod Ricard）的老板最近向彭博社透露，他经常一晚上跑好几家酒吧，就为了解人们爱喝什么。如果你公司的产品是公厕皂液器，做这样的研究就远没有那么有趣了，但道理是一样的。

你可以试试购买自家产品，拨打自家服务热线，忍受让人咬牙切齿的同款等待音乐。你也可以直接听取顾客的意见。刚被任命为英国财政大臣的杰里米·亨特（Jeremy Hunt）曾是英国任职时间最长的卫生大臣，那会儿他每天早上都会先看一封病人或病人家属的投诉信，然后亲自回复。你只要每周取消一场内部会议，把时间用来听取客户意见，你就能在同行中脱颖而出。

这个理念不仅适用于客户，也可能适用于公司内部。站在员工的角度观察，老板们会了解到是什么在拖累生产率、削弱士气，又是什么让员工感到被器重。与其他员工住在同一个社区有助形成亲和力。最近有研究发现，在丹麦，住在距办公室五公里范围内的CEO似乎比住得更远的CEO更能营造良好的工作环境。但除了搬家，管理者还有什么别的办法走进员工的内心世界？

即使老板真想听不加粉饰的大实话，员工可能还是很难一吐为快。匿名调查有助鼓励大家坦诚直言，离职面谈也有这样的效果，但即使动用这些形式，员工也可能言而不尽。Glassdoor等招聘网站上的评论可以非常直截了当，但评论发布者的动机不一定能看得明白。Slack这类办公即时通讯应用给管理者提供了一扇半开的窗户来了解一些团队的进展，但监视不是共情。上述这些都不等于切身了解员工的真实处境与感受。

管理者很难复制一般员工的经历。老板要用哪个房间，那个房间就会神奇地立刻腾了出来，其他人则像离群的角马般在办公楼里游荡。管理者不必提醒别人自己的尊姓大名。他们也不太能体会到那些会减损员工工作热情的常见感受，比如被忽视或不被赏识。相比员工，管理者被同事不礼貌对待的几率也低得多。

一个办法是参加娱乐真人秀节目《卧底老板》（Undercover Boss）。在节目中，高管们换上各种稀奇古怪的伪装，到自己的公司里工作，去了解员工的实际生活。选择这条路，你会看到很多东西，但同时不得不向数百万观众承认，你对自己公司的内部情况一无所知。（简单一点的方法是省去摄像机，就自己乔装打扮一番后混进办公室——就怕假胡子在关键时刻掉下来。）

即使不做微服私访，管理者花点时间体验手下干的活也是件好事。（不再指称别人为下属也是件好事。）已经有航空公司和零售商把高管送到机场和门店的一线岗位上工作一段时间。外卖送货应用DoorDash有一个名为WeDash的项目，要求正式员工定期参与接单送货。另外老板们可以自己做一些其他没有助理的人必须独自完成的事。填报销单是个繁琐乏味的活：人人都该自己干，至少偶尔该试试。一般情况下，老板们坐飞机时应和同事们选同样的舱位。诸如此类。

如果说管理者站在员工的角度能领悟到一些东西，员工也值得花时间想想做老板是什么样的。那不只是商务舱出行和众声附和。想象一下，你一走进电梯，周围的对话总是戛然而止。想象无时不刻都有人在背后嘟哝埋怨你。或者你知道，你若不出现，大家的气氛就会轻松愉悦许多。想象再棘手的决策都得你自己做，没法请你上司出马。别看老板们穿着光鲜亮丽的好鞋，那鞋子也是会夹脚的。■



Biological neural networks

Nerve cells in a dish can learn to play Pong

That may help design better information-processing techniques

SOMETHING NEW is on the menu of neuroscience. It is called “DishBrain”. This is not a recently discovered regional delicacy, but rather a network of nerve cells, grown on a computer chip, which is capable of interacting with the outside world via that chip. As a proof of principle, Brett Kagan, chief scientific officer of Cortical Labs, a small firm in Melbourne, Australia, and his collaborators, have taught the cells to play Pong, an early video game that resembles an electronic form of table tennis.

DishBrain is smaller than a human being’s little-finger nail and contains fewer nerve cells than a bee. Those cells are grown from pluripotent stem cells, which are, in turn, derived from ordinary body cells, and can differentiate into more or less any sort of tissue. Dr Kagan experimented with cells from both mice and humans.

Growing the network on the chip was only part of the story, though. Getting it to perceive and interact with the world was, as he describes in a paper in *Neuron*, quite another. The chip had predefined “sensory” (input) and “motor” (output) regions. In the sensory region, eight electrodes gave the cells tiny zaps that communicated the positions of the paddle (there was only one; the network was playing against a “wall”) and the ball with respect to one another. The neurons’ firings in the motor region determined the movement of the paddle.

By randomly zapping the sensory neurons for four seconds every time the network missed the ball, the software running the chip wiped out the pattern that led to the loss. Conversely, winning plays, which did not lead to random zapping, were retained.

The result was that the nerve cells first learned the rules of Pong, and then learned to play it better. For both species' cells the average rally time increased noticeably over the course of 20 minutes—though gratifyingly for humanity's amour propre, the human cells slightly, but consistently, outperformed those from mice.

Natural neural networks (the brains of human beings) and artificial ones (software models of how people once thought networks of nerve cells behave) have long been able to play Pong. Yet both have limitations. It is technically difficult, and often ethically impossible, to study in detail how brains work (though this is changing). And, neuroscience having moved on, it is now known that artificial neural networks are fundamentally different from their biological counterparts. Dr Kagan hopes, therefore, that the benefits of DishBrain will go beyond Pong, by giving researchers a better understanding of how nerve cells learn—and therefore opening a new avenue for biologically inspired information processing. ■



生物神经网络

培养皿中的神经细胞能学会玩乒乓球游戏

这可能有助于设计更好的信息处理手段【新知】

神经科学的菜单上有了新东西，叫“皿中之脑”（DishBrain）。这不是什么新近发现的地方特色佳肴，而是个神经细胞网络，生长在一个计算机芯片上，能够通过这个芯片与外部世界交互。为了证明其原理，澳大利亚墨尔本的一家小公司Cortical Labs的首席科学官布莱特·卡根（Brett Kagan）和合作者教会了这些细胞玩一款早年间的游戏《乓》（Pong），类似于电子形式的乒乓球。

皿中之脑比人的小指指甲还小，包含的神经细胞比一只蜜蜂的还少。这些细胞是从多能干细胞中生长出来的，这些多能干细胞又是来自普通的身体细胞，差不多可以分化形成任何种类的组织。卡根的实验既使用了小鼠的细胞也使用了人类的细胞。

不过，在芯片上培养神经网络只是任务的一部分。正如卡根发表在《神经元》（Neuron）期刊上的一篇文章中所描述的，让它感知世界并与之互动就是另一码事了。这个芯片上有预先定义的“感觉”（输入）区和“运动”（输出）区。在感觉区，八个电极向细胞发送微小的电流脉冲以传达球拍（只有一个球拍，神经网络是对着一面“墙”打球）和球相对于彼此的位置。运动区神经元的放电控制球拍的运动。

每当神经网络没接到球，运行芯片的软件就随机电击感觉神经元4秒钟，由此消除导致丢球的模式。相反，成功接到球的模式（不会受到随机电击）会被保留下来。

结果是神经细胞先是学会了《乓》的规则，后来又学会了把它玩得更好。在20分钟的训练中，两个物种的细胞的平均连续击球时间都显著拉长。不过人类细胞的表现略微但持续优于小鼠细胞——满足了人类的自尊心。

自然神经网络（人脑）和人工神经网络（软件模型，模拟人们曾经以为的神经细胞网络运作方式）早就能玩《乓》了。然而两者都有局限性。深入地研究大脑如何在技术上有难度，在伦理上通常也不可能（不过这正在改变）。而且，随着神经科学的发展，现在人们已经知道人工神经网络与自然神经网络有着根本的不同。因此，卡根希望皿中之脑的好处将不止于玩《乓》，而是能让研究人员更好地了解神经细胞是如何学习的——从而开辟用生物学启发信息处理的新路径。■



Consultants under fire

Do McKinsey and other consultants do anything useful?

Though hated, they often provide a valuable service to the economy

IF A LIST were made of the most reviled species in the professional world, only investment bankers would stand between management consultants and the top spot. Sceptics portray these corporate consiglieri as snake-oil salesmen, bamboozling chief executives and politicians with management gibberish and glossy charts while gorging on fat fees. Indeed, the profession was once the subject of a five-season skewering in a star-studded TV series. Its title: “House of Lies”.

Recent events have provided even more reasons to hate consultants. “When McKinsey Comes to Town”, an exposé published on October 4th, drags its subject through the mud with evidence of decades of scandalous behaviour. On September 30th prosecutors in South Africa brought criminal charges against the firm. (McKinsey says the book is a misrepresentation and denies the charges brought against it.) Its two big rivals, Bain & Company and the Boston Consulting Group (BCG), have also faced controversies. In France President Emmanuel Macron has come under attack after an inquiry this year found the government had spent \$1bn on consulting firms with “tentacular” links with the state.

Despite evidence of dubious conduct, business has never been better. The big three firms’ total revenue has tripled since 2010, to about \$30bn; the trio now employ around 70,000 people. That implies revenue per employee of over \$400,000, hinting at juicy pay packets for the people at the top. By comparison, the figure for the big four accountancy firms—Deloitte, PWC, EY and KPMG—is a comparatively meagre \$140,000.

What explains the boom? A shroud of secrecy makes it hard to calculate

how much value the industry adds: few bosses or politicians would credit consultants for a successful turnaround. As a result there is a widespread view that all consultants are parasites and those who hire them are fools. In fact the firms have grown because they provide two services that bosses want—one more economically beneficial than the other.

The first is an outside opinion. When firms or governments make decisions, it can pay to buy in rigorous analysis. The danger is that this becomes a self-protection racket. When bosses want to push through controversial decisions, from firing staff to breaking up a firm, a consultant's backing can bolster their credibility. And legitimate scrutiny, whether from political opponents or board directors, can be easier to dodge using consultants' reports in pleasing fonts with scientific-looking tables.

The second service is unambiguously good, both for the people in charge and the wider economy: making available specialist knowledge that may not exist within some organisations, from deploying cloud computing to assessing climate change's impact on supply chains. By performing similar work for many clients, consultants spread productivity-enhancing practices.

One defence against an explosion of bogus advice would be better disclosure. Companies are already required to reveal how much they spend on their auditors and on investment bankers' fees on deals. The sums that individual firms spend on consultants often exceed this, running into the tens of millions of dollars a year, and should be made public too.

So far the industry has escaped the formal rules that govern lawyers and bankers. If it wishes to keep it that way, it should adopt a second measure: a code of conduct that all responsible consultancies adhere to. They should eschew providing advice that helps bigwigs at the expense of the institutions they run, or helps autocrats oppress their people. They should

also police the revolving door between government jobs and consultancies.
Consultants have much to offer, but also much still to prove. ■



【首文】炮轰顾问

麦肯锡等咨询公司做了任何有用的事吗？

尽管遭人厌，但它们常常为经济提供有价值的服务

如果把最受诟病的职业列出一张清单，能排在管理顾问前面的也只有投资银行家了。怀疑人士说这些企业军师实则是卖狗皮膏药的，用胡说八道的管理学术语和精致的图表忽悠首席执行官和政客，大把赚取高额费用。事实上，这个职业曾经是一部演了五季的明星云集的电视剧尖锐嘲讽的对象。剧名叫“谎言屋”（House of Lies）。

最近发生的事件让人们有更多理由痛恨管理顾问了。爆料书《麦肯锡进城啦》（When McKinsey Comes to Town）在10月4日上架，向大众一一列举这家公司几十年来的各种丑闻。9月30日，南非的检察官对麦肯锡提出了刑事指控。（麦肯锡称这本书内容不实，并否认了控罪。）它的两大竞争对手贝恩和波士顿咨询公司也都面对争议。在法国，今年的一项调查发现马克龙政府在与它有“多触角”联系的咨询公司上支出了10亿美元，总统因此受到抨击。

尽管有可疑行径的证据，生意却是前所未有的好。2010年以来，三大咨询公司的总营收增长了两倍，达到约300亿美元，它们共计雇用了约7万名员工。这样平均到每名员工的营收超过40万美元，也就意味着高层人员薪酬丰厚。相比之下，德勤、普华永道、安永和毕马威这四大会计师事务所的人均营收只有14万美元。

生意火爆的原因是什么？咨询行业披着的神秘面纱让外界很难计算它到底带来了多少价值——很少有企业老板或政客在成功扭转局面后会把功劳归于顾问。也因此，人们普遍认为顾问都是寄生虫，付费咨询的人都是傻瓜。事实上，这些公司之所以不断发展壮大，是因为它们提供了老板想要的两种服务，其中一种比另一种更具经济效益。

第一种是外部意见。公司或政府在做决策时，购买严谨的分析服务可能是

值得的。危险在于这会变成一种自我保护的勾当。当老板想要推动通过有争议的决策时——从解雇员工到分拆公司等，顾问的支持可以提高自己的可信度。拿着字体美观、包含看上去很科学的图表的咨询报告，也更容易躲避政治对手或董事的正当质疑。

第二种服务则是百分百有益的，无论是对主事的人，还是对更广泛的经济而言。咨询公司能够提供一些组织内部可能不具备的专业知识，从部署云计算到评估气候变化对供应链的影响。通过为许多客户提供相似的服务，咨询公司把提高生产率的做法推而广之。

防止空洞建议激增的一种措施是加强披露。企业已经被要求披露它们在交易中支付给审计机构和投行的费用。单个企业付给咨询公司的费用往往高过以上支出，一年能有数千万美元，也应公之于众。

到目前为止，咨询行业还没有像律师和银行家那样受到正式规管。如果它希望保持这种局面，就应该采取第二项措施——制定所有负责任的咨询公司都遵守的行为准则。它们在提供建议时应避免为帮助大人物而牺牲他们所经营的机构，或者帮助独裁者压迫他们的人民。它们还应该监督政府职位和咨询公司之间的旋转门现象。顾问们是有真材实料的，但也有很多需要证明的。■



The housing horror show

A global house-price slump is coming

It won't blow up the financial system, but it will be scary

OVER THE past decade owning a house has meant easy money. Prices rose reliably for years and then went bizarrely ballistic in the pandemic. Yet today if your wealth is tied up in bricks and mortar it is time to get nervous. House prices are now falling in nine rich economies. The drops in America are small so far, but in the wildest markets they are already dramatic. In condo-crazed Canada homes cost 9% less than they did in February. As inflation and recession stalk the world a deepening correction is likely—even estate agents are gloomy. Although this will not detonate global banks as in 2007-09, it will intensify the downturn, leave a cohort of people with wrecked finances and start a political storm.

The cause of the crunch is soaring interest rates: in America prospective buyers have been watching, horrified, as the 30-year mortgage rate has hit 6.92%, over twice the level of a year ago and the highest since April 2002. The pandemic mini-bubble was fuelled by rate cuts, stimulus cash and a hunt for more suburban space. Now most of that is going into reverse. Take, for example, someone who a year ago could afford to put \$1,800 a month towards a 30-year mortgage. Back then they could have borrowed \$420,000. Today the payment is enough for a loan of \$280,000: 33% less. From Stockholm to Sydney the buying power of borrowers is collapsing. That makes it harder for new buyers to afford homes, depressing demand, and can squeeze the finances of existing owners who, if they are unlucky, may be forced to sell.

The good news is that falling house prices will not cause an epic financial bust in America as they did 15 years ago. The country has fewer risky loans and better-capitalised banks which have not binged on dodgy subprime

securities. Uncle Sam now underwrites or securitises two-thirds of new mortgages. The big losers will be taxpayers. Through state insurance schemes they bear the risk of defaults. As rates rise they are exposed to losses via the Federal Reserve, which owns one-quarter of mortgage-backed securities.

Some other places, such as South Korea and the Nordic countries, have seen scarier accelerations in borrowing, with household debt of around 100% of GDP. They could face destabilising losses at their banks or shadow financial firms: Sweden's central-bank boss has likened this to "sitting on top of a volcano". But the world's worst housing-related financial crisis will still be confined to China, whose problems—vast speculative excess, mortgage strikes, people who have pre-paid for flats which have not been built—are, mercifully, contained within its borders.

Even without a synchronised global banking crash, though, the housing downturn will be grim. First, because gummed-up property markets are a drag on the jobs market. As rates rise and prices gradually adjust, the uncertainty makes people hesitant about moving. Sales of existing homes in America dropped by 20% in August year on year, and Zillow, a housing firm, reports 13% fewer new listings than the seasonal norm. In Canada sales volumes could drop by 40% this year. When people cannot move, it saps labour markets of dynamism, a big worry when companies are trying to adapt to worker shortages and the energy crisis. And when prices do plunge, homeowners can find their homes are worth less than their mortgages, making it even harder to up sticks—a problem that afflicted many economies after the global financial crisis.

Lower house prices also hurt growth in a second way: they make already-gloomy consumers even more miserable. Worldwide, homes are worth about \$250trn (for comparison, stockmarkets are worth only \$90trn), and account for half of all wealth. As that edifice of capital crumbles,

consumers are likely to cut back on spending. Though a cooler economy is what central banks intend to bring about by raising interest rates, collapsing confidence can take on a momentum of its own.

A further problem is concentrated pain borne by a minority of homeowners. By far the most exposed are those who have not locked in interest rates and face soaring mortgage bills. Relatively few are in America, where subsidised 30-year fixed-rate mortgages are the norm. But four in five Swedish loans have a fixed period of two years or less, and half of all New Zealand's fixed-rate mortgages have been or are due for refinancing this year.

When combined with a cost-of-living squeeze, that points to a growing number of households in financial distress. In Australia perhaps a fifth of all mortgage debt is owed by households who will see their spare cashflow fall by 20% or more if interest rates rise as expected. In Britain 2m households could see their mortgage absorb another 10% of their income, according to one estimate. Those who cannot afford the payments may have to dump their houses on the market instead.

That is where the political dimension comes in. Housing markets are already a battleground. Thickets of red tape make it too hard to build new homes in big cities, leading to shortages. A generation of young people in the rich world feel they have been unfairly excluded from home ownership. Although lower house prices will reduce the deposit needed to obtain a mortgage, it is first-time buyers who depend most on debt financing, which is now expensive. And a whole new class of financially vulnerable homeowners are about to join the ranks of the discontented.

| *Dangerous properties*

Having bailed out the economy repeatedly in the past 15 years, most Western governments will be tempted to come to the rescue yet again. In

America fears of a housing calamity have led some to urge the Fed to slow its vital rate rises. Spain is reported to be considering limiting rising mortgage payments, and Hungary has already done so. Expect more countries to follow.

That could see governments' debts rise still further and encourage the idea that home ownership is a one-way bet backed by the state. And it would also do little to solve the underlying problems that bedevil the rich world's housing markets, many of which are due to ill-guided and excessive government intervention, from mortgage subsidies and distortive taxes to excessively onerous planning rules. As an era of low interest rates comes to an end, a home-price crunch is coming—and there is no guarantee of a better housing market at the end of it all. ■



【首文】房市万圣节

全球房价摇摇欲坠

虽然不会摧毁金融体系，但仍将动魄惊心

过去十年里，持有房产就意味着轻松赚钱。多年来房价一直稳步上涨，在全球疫情期间还怪异地飙升了。然而时至今日，如果你的财富被套在房产上，那你就该心里不踏实了。九个发达经济体的房价都在跌。迄今为止美国的跌幅还不小，但在最疯狂的市场上房价已经跌得触目惊心。在热衷共管公寓的加拿大，房价较2月时下跌了9%。随着通货膨胀和衰退的风险在全球蔓延，很可能发生一场深度调整——即使地产中介也感到悲观。尽管这次不会像2007到2009年那样让全球银行爆雷，但却会加剧衰退，让部分人陷入财务困境，并引发一场政治风暴。

危机的原因是利率飙升：在美国，有意购房者目瞪口呆地看着30年期按揭利率攀升至6.92%，比一年前高出一倍多，是2002年4月以来的最高点。降息、经济刺激资金和追捧郊区生活空间，这些因素驱动了疫情期间的小型泡沫，而现在它们几乎都在逆转。举例来说，假设一年前某人可以负担月供1800美元、30年期的按揭贷款，当时他可以借到42万美元。如今，这笔月供只能贷到28万美元，少了33%。从斯德哥尔摩到悉尼，借款人的购买力正在崩溃。这使得新买家更难买得起房子，抑制了需求，并可能令有房者的财务承压，如果运气不好，他们可能还得被迫卖掉房子。

好消息是，房价下跌不会像15年前那样在美国引发一场金融业的腥风血雨。这次美国的高风险贷款较少，银行的资本更充足且不再大量持有危险的次贷证券。现在，三分之二的新按揭贷款都由美国政府担保或证券化。大输家将会是纳税人。他们通过国家保险计划而承担了违约风险。美联储持有四分之一的按揭抵押证券，随着利率上升，纳税人可能因此而蒙受损失。

在韩国和北欧等地，之前的借贷增速更加惊人，家庭债务约达到GDP的100%。这些国家的银行或影子金融机构可能面临威胁系统稳定性的巨大

损失：瑞典央行行长将之形容为“坐在火山口”。但世界上最严重的住房相关金融危机仍将局限于中国，所幸，中国的问题——巨量的过度投机、业主集体停贷、预售楼盘烂尾——都限于境内。

然而，即使全球银行业不会同步崩溃，房地产低迷仍将是个严重的问题。首先是因为停滞的房地产市场会拖累就业市场。随着利率上升和价格逐步调整，不确定性让人们对于迁移犹豫不决。美国8月的现房销量同比下降了20%，房地产公司Zillow报告称，本季新挂牌的房屋数量比往常减少了13%。加拿大今年的销量可能会下降40%。当人们无法流动时，就会削弱劳动力市场的活力，这在企业努力应对劳动力短缺和能源危机之际是个巨大的忧患。而一旦房价真的暴跌，房主可能发现自己房子的价值低于贷款额了，这使得他们更难迁居别处——全球金融危机后许多经济体就受到这个问题的困扰。

房价下跌还以另一种方式损害经济增长：它让本已沮丧的消费者更加窘迫。全球的房产价值总额约250万亿美元（相比之下，股市仅为90万亿美元），占到全部财富的一半。随着这一资本高楼轰然倒塌，消费者很可能会削减支出。尽管各国央行加息只是为了给经济降温，但信心崩溃可能形成自己的势头。

进一步的问题是痛苦尤其集中在少数房主身上。受影响最大的无疑是那些没有锁定利率、面临按揭供款飙升的人。这种情况在美国相对较少，因为那里普遍采用有补贴的30年期固定利率按揭贷款。但在瑞典，80%的贷款只有两年或更短的锁定期限；在新西兰，一半的定息抵押贷款在今年已经到期或者即将需要重新按揭。

要是再加上生活成本的上升，就会有越来越多的家庭陷入财务困境。澳大利亚约五分之一的按揭债务是家庭欠下的，如果利率如预期上升，他们的可支配现金流将减少20%或更多。据一项估计，在英国，有两百万户家庭的按揭贷款将再多耗掉他们10%的收入。无力继续供款的人可能不得不把房子放到市场上抛售。

这就会触发政治层面的动荡了。房地产市场本已是战场。繁琐的程序使得在大城市建造新房非常困难，导致住房短缺。发达国家的年轻一代感觉到他们被不公平地剥夺了拥有住房的权利。尽管房价降低会减少申请按揭所需的首付，但这些首次购房者恰恰又最依赖举债融资，而如今借债成本高昂。一批房主的财务状况岌岌可危，将壮大不满者的队伍。

| 房市危局

在过去15年里，大多数西方政府曾反复为经济纾困，如今会很想要再度出手救助。在美国，对房地产崩盘的担忧让一些人敦促美联储放慢其至关重要的加息步伐。据报道，西班牙正在考虑给不断上涨的按揭供款设限，而匈牙利已经付诸实践。预计会有更多国家效仿。

这可能会导致政府债务进一步上升，并助长那种买房有政府兜底、稳赢不赔的想法。而且，它也无助于解决困扰发达国家房地产市场的根本问题，其中许多问题正是源于不当又过度的政府干预——从按揭补贴、扭曲的税制，到过于繁重的规划条例，等等。随着低利率时代走向终结，一场房价崩盘正在来袭——而在一切尘埃落定之后，没人能保证房地产市场会变得更好。■



No other way but through

“Life is Hard” is a consoling guide to this vale of tears

Woe is inevitable, argues Kieran Setiya’s humane book. But clear thinking can help

Life is Hard. By Kieran Setiya. Riverhead Books; 240 pages; \$27. Hutchinson Heinemann; £16.99

FOR MANY years, Kieran Setiya has suffered from chronic pain. Aristotle and many philosophers since have judged that such an affliction, like other major harms, must diminish or spoil a good life. Mr Setiya, a well-regarded professor of philosophy at the Massachusetts Institute of Technology, disagrees. “Life is Hard” is his wry and ever-thoughtful explanation of why.

Its short, engagingly written chapters examine six banes of life in turn: infirmity (including pain), loneliness, grief, failure, injustice and “absurdity”, or a sense of life’s futility. Everyone faces some of them at one time or another. Many people face several all the time. If suffering is in practice unavoidable, how is a good life possible?

A good question, but Mr Setiya aims to show how living well and hardship can go together. There is no single good life for everyone, he argues at the beginning. Such lives can include—but do not require—feeling happy. They involve the well-being of others, not just your own, a point reprised in the chapter on injustice. A good life also need not require you to define, let alone pursue, an ideal one: “The best is often out of reach.”

As for life’s banes, saying that people “should not turn away from hardship” is not to call for self-mortification out of religious guilt. Nor is Mr Setiya claiming, in Stoic or Buddhist fashion, that people can make pain, loneliness and the rest go away by persuading themselves not to care about their effects. Hardships are bad and best avoided. They should be

minimised where possible but, where not, better understood and better described. To that main task “Life is Hard” then turns, with a mix of personal anecdote, analytical bite and refreshing distrust, based on factual evidence, of much received wisdom.

The chapter on “Infirmity” cites evidence that the handicapped can live as well as the non-handicapped. Pain, especially chronic pain, is different. Mr Setiya pores over the different ways pain is understood and talked about. He rejects the once-standard picture of pain as a grim but thoughtless feeling. “Pain”, he counters, “is not lost for words.”

“Loneliness” rejects a suspect picture of modern society as peopled by the lonely and disconnected. Instead, it focuses on particular harms, notably the widespread use of solitary confinement in American prisons. In analytical mode, it probes why love and friendship matter and what harm their absence causes. Most readers will think the answers are obvious until they try to put them into words. Again, Mr Setiya’s distinctions come to their aid.

As for grief, Epicurus was wrong: it is not unreasonable. Death matters. It harms survivors (through loss of the dead) and the dead themselves (who are deprived of more life). Yet there comes a time for the bereaved to slow up or stop: “The tempering of grief is not betrayal.” The chapter on “Failure” is less strong, but before false reassurance can take hold, Mr Setiya turns to justice. A good life, he presses, involves resisting injustice, for the well-being of any one person depends on that of others. Rather than guilty payment for past wrongs, he contends, pursuing justice should mean attending to social inequities now and planetary ruin to come.

It also gives life a purpose, so answering glum thoughts of its futility. And it offers grounds for hope, the topic of Mr Setiya’s final chapter, in which he makes more nice distinctions and quietly reminds readers that he knows

what he is talking about from personal experience.

“Life is Hard” will disappoint those looking for glibly reassuring self-help. It ambles and chats, citing a delightful range of writers and thinkers (and the occasional luminary of baseball); then a lot of compressed thought and sketched argument goes by in a few brisk paragraphs. It may unsettle academic philosophers with fixed notions of industry standards. Those features, however, are part of its strength. Attentive readers of this humane, intelligent book will come away with a firmer grasp and better descriptions of whatever it is that ails them or those they cherish. ■



唯有走过

《人生维艰》是给无边苦海的安慰性指引

基兰·塞蒂亚充满人文关怀的新书认为苦难在所难免，但清晰思考有助纾解【《人生维艰》书评】

《人生维艰》，基兰·塞蒂亚著。Riverhead出版社，240页，27美元；哈金森海涅曼出版社，16.99英镑。

基兰·塞蒂亚（Kieran Setiya）多年来一直受慢性疼痛之苦。亚里士多德和他之后的许多哲学家都认为这种痛苦就像其他严重伤害一样，肯定是对美好人生的折损。但塞蒂亚这位麻省理工学院备受尊敬的哲学教授倒不这么认为。他在《人生维艰》（Life is Hard）中给出的解释幽默自嘲又富于深思。

这本书用短小精悍的章节依次审视了人生六大苦：病弱（包括疼痛）、孤独、悲伤、失败、不公、“荒诞”（即生命的虚无感）。每个人都会在人生的某个节点面对这其中某些苦，许多人更是自始至终承受着好几种。如果苦难实际上无可避免，那何来所谓的美好人生？

好问题。但塞蒂亚的书想要展示美好人生和艰难困苦可以并存。他在开篇就指出，没有一种适用于所有人的美好人生。美好人生可以包含幸福感，但不是必须有。其中涉及的不只有自己的福祉，还有他人的福祉，书中关于不公的章节再次提到这一点。美好人生也不需要你去定义一种理想生活，更遑论去追求。“最好的往往遥不可及。”

至于生活中的苦，说大家“不应回避困苦”并不是要呼吁人们出于宗教中的愧疚感而去苦行。塞蒂亚也不是像斯多葛派或佛教那样，声称人们只要说服自己“放下”疼痛、孤独等苦难对自己的影响，这些苦就会自然消失。苦难不是好事，能免则免。可以的话，应尽量减少它们，但如果不能，就该更好地去理解和描述它们。这正是《人生维艰》接下来的主要着墨之处，其中参杂了个人轶事、犀利的分析，以及基于实证对许多普遍观念提出新

颖的质疑。

关于“病弱”的章节援引证据说明残疾人可以过得和正常人一样好。疼痛，尤其是慢性疼痛，则不一样。塞蒂亚仔细审视了人们理解和谈论疼痛的不同方式。他驳斥了以往的标准化描述，即把疼痛说成是一种让人日子难过但并不涉及思考和认知的感觉。“疼痛”，他反驳说，“并非无以言表”。

对于现代社会中的人往往孤独疏离的可疑观点，“孤独”这一章没有采信。它着力于讨论孤独带来的特定危害，特别是美国监狱中广泛采用的单独囚禁。它并进入分析模式，探究爱和友谊的重要性及其缺失造成的伤害。大多数读者会认为答案显而易见，但实际上并不容易明确论证。在这里，塞蒂亚的辨析再一次帮助人们清晰思考。

至于悲伤，伊壁鸠鲁的观点不对，悲伤并不是过度而不明智的。死亡事关重大，既伤害死者本身（他们失去了生命），也伤害幸存者（失去了死者）。但丧亲者终会节制或停止悲伤：“节哀不是背叛。”“失败”这一章稍欠说服力，不过没等做多少空洞的安慰，塞蒂亚已转到有关正义的话题上。他强调，美好的人生需要抵制不公，因为任何人的福祉都取决于其他人的福祉。他认为，追求正义不是为过往的错误赎罪，而是要关注眼下的社会不公和未来的地球危机。

这也让生命获得了目的，从而回应了“人生虚无”的颓丧想法。它也让人们有理由心存希望，而这是本书最后一章的主题。塞蒂亚在此做了更多细致的辨析，并且不着痕迹地提醒读者，鉴于自己的个人经历，他并非信口开河。

爱看振振有词却肤浅空洞的自我成长励志图书的读者会对《人生维艰》感到失望。作者仿佛与友人闲聊漫谈，一路引用五花八门的作家和思想家（偶尔还有棒球明星），趣味盎然；在短短几段话中已有许多思想精华与观点概要越过眼帘。它也许会让那些坚持行业标准的学院派哲学家感到不适。然而，这些特点正是其优点的一部分。这是一本充满人文关怀和智慧的书。读罢释卷，用心的读者会更明白也更能说清楚自己及自己珍视之人

所受的苦到底是什么。■



The Golden State's golden egg

Peter Thiel says California suffers from a “tech curse”. Is he right?

The state is fabulously rich and fabulously dysfunctional

SPEAKING RECENTLY at the National Conservatism Conference in Miami, Peter Thiel, an investor and intellectual, made a provocative argument. He suggested that California suffers from a “tech curse”: a play on the “resource curse”, the notion that countries with abundant natural resources often have weak economies and corrupt political systems. If data is the new oil, then California is the new Saudi Arabia—even, he said, if things aren’t quite “as bad as Equatorial Guinea”.

Mr Thiel made the Equatorial Guinea comparison with tongue firmly in cheek, but he was deadly serious about the tech-curse theory. At first glance it seems plausible. California’s tech industry has in recent years produced astonishing wealth. The state is also in many ways dysfunctional. Parts of downtown San Francisco resemble an open-air drug den. Many of the state’s public schools seem keener on talking about social justice than teaching children. Each year, one in every 100 Californians, on net, leaves for another state.

Mr Thiel thinks that California’s poverty and prosperity are two sides of the same coin, with state and local governments providing the link. Public-sector employees draw on tech’s enormous tax revenues to overpay themselves and do no work, he says. The state’s tech moguls in effect buy off politicians, ensuring, for example, that they enact super-restrictive planning regulations to keep house prices high.

It is in vogue to criticise both California and tech: doing both at the same time left the audience in raptures. There is also a grain of truth to what Mr Thiel says. But there are two big problems with his theory.

Take the benefits offered by California's tech industry first. Tech has, in fact, turned the state into a growth superstar, not a laggard. In the past five years, California's state-level GDP has grown by 18%, the fourth-fastest rate in the country and a better performance than either Florida or Texas (see chart). Even subtracting tech, California's growth was above average, according to our calculations. Less fashionable industries such as chemicals manufacturing have also done well in recent years.

Many of the proceeds of this growth have gone on enormous mansions in Atherton and Los Altos, but they have also trickled down to a greater extent than Mr Thiel appreciates. Just over a decade ago the median Californian household had an income 7% higher than the median American one. Now their income is 15% higher. The unemployment rate, relative to the national average, has fallen. So has poverty. And there is little to suggest that the decline in joblessness or poverty is caused by poor people leaving the state.

Mr Thiel also overstates tech's costs. It is true that some of California's politicians behave with nearly as much impunity as the Saudi elite. Yet anyone with a passing knowledge of Californian history knows that dirty dealing in politics long predates tech. San Francisco's politics today is tame in comparison with the 1970s.

It is similarly hard to blame tech for California's housing market. The ratio of California's average house price to America's is much lower than in the mid-2000s. Meanwhile, California's anti-building rules, the cause of sky-high prices, emerged with the environmentalist movement of the 1970s, not Mark Zuckerberg and Elon Musk. There is a lot to dislike about Big Tech, but it is not as malign as Mr Thiel believes. ■



金州的金蛋

彼得·蒂尔说加州遭受“科技诅咒”。是这样吗？

加州异常富裕也异常失调

最近在迈阿密举行的全国保守主义会议（National Conservatism Conference）上，投资者、知识分子彼得·蒂尔（Peter Thiel）发表了一个极富争议的观点。他认为加州遭受了“科技诅咒”（借用了“资源诅咒”一说，指拥有丰富自然资源的国家往往经济疲软、政治制度腐败）。假如数据是新的石油，那么加州就是新的沙特阿拉伯，即使情况还不至于“像赤道几内亚那样糟糕”，他说。

蒂尔拿赤道几内亚来比较纯属戏言，但他谈论科技诅咒是绝对认真的。乍看之下它似乎确有道理。近年来，加州的科技业创造了惊人的财富，但该州在许多方面却失调了。旧金山市中心的部分地区就像个露天毒窟。加州许多公立学校似乎更热衷高谈阔论社会正义而非教育孩子。每年净流出加州的人口占该州总人口的百分之一。

蒂尔认为，加州的贫困和繁荣是一个硬币的两面，把这两面联系起来的是州政府和地方政府。他指出，公共部门的雇员仰仗科技行业贡献的巨额税收，拿着过高的薪酬却无所作为。加州的科技大亨实际上是在收买政客来确保一些利益，例如让政府制定限制性极强的区域规划法规，使当地房价保持高位。

批评加州和科技业已成为一种风尚：同时对两者大加批评更是让听者大呼过瘾。蒂尔的话有一定道理。但他的理论有两大问题。

先看科技业给加州带来的好处。事实上，科技业让加州成了经济增长的超级明星，而非落后者。过去五年，加州整体GDP增长了18%，增速排名全国第四，高于佛罗里达和得克萨斯（见图表）。据本刊计算，即便不算科技业，加州的增速也高于美国平均水平。化学品制造等没那么时髦的行业近年也表现不俗。

这些增长带来的许多收益流向了阿瑟顿和洛斯阿尔托斯区的豪宅，但也点滴惠及其他方面，程度比蒂尔所想的要大。十多年前，加州的家庭收入中位数比美国整体高7%，现在是高15%。相对美国平均水平，加州的失业率和贫困率均有所下降。没有什么迹象表明这两者下降是因为穷人离开了加州。

蒂尔也夸大了科技业造成的代价。加州的一些政客确实像沙特的精英们一样无法无天。但对加州历史略知一二的人都知道，龌龊的政治交易早在科技业兴盛前很久就已存在。与上世纪70年代相比，现在旧金山政界算是规矩的。

同样，加州住房市场的问题也很难归咎于科技业。目前加州平均房价与美国整体房价之比大大低于2005年左右。同时，加州的反建筑法规这一高房价的源头是与上世纪70年代的环保主义运动相伴而来，而非随扎克伯格和马斯克而来。科技巨头有很多招人厌的地方，但不至于像蒂尔认为的那么恶贯满盈。 ■



Green-dustrialisation

Can Europe decarbonise its heavy industry?

Yes, though it won't be easy

SWEDISH STEEL is considered the world's toughest. It may soon become its greenest. In Boden, a town near the Arctic Circle, a startup called H2 Green Steel (H2GS) is erecting a €4bn (\$4bn) new mill, Europe's first in nearly half a century. It will be powered not by the usual coal or natural gas but by green hydrogen, produced on site by the region's abundant wind and hydropower. When fully built in a few years, it will employ up to 1,800 people and churn out 5m tonnes of steel annually.

The project matters far beyond sparsely populated northern Sweden. The consequences could be momentous for the continent's producers of steel and other basic materials, such as cement and chemicals, which between them directly contribute around 1% of the EU's GDP. It would ripple through the supply chains of firms, from carmakers to builders, which account for another 14% of EU output, according to Material Economics, a think-tank. It would boost Europe's energy independence, the importance of which has been laid bare by Russia's energy blackmail in response to Western sanctions against its war in Ukraine. And it would be a boon for the climate, since basic-materials industries spew out about a fifth of Europe's greenhouse-gas emissions. It could in short, thinks Ann Mettler of Breakthrough Energy, a venture-capital fund backed by Bill Gates, mark the rebirth of Europe's heavy industry for the post-fossil-fuel era.

Heavy industry has long seemed irredeemably carbon-intensive. Reducing iron ore to make steel, heating limestone to produce cement and using steam to crack hydrocarbons into their component molecules all require a lot of energy. On top of that, the chemical processes involved give off lots of additional carbon dioxide. Cutting all those emissions, experts believed,

was either technically unfeasible or prohibitively expensive.

Both the economics and the technology are at last looking more favourable. Europe is introducing tougher emissions targets, carbon prices are rising and consumers are showing a greater willingness to pay more for greener products. Several European countries have crafted strategies for hydrogen, the most promising replacement for fossil fuels in many industrial processes. Germany is launching the Hydrogen Intermediary Network Company (HINT.co for short), a global trading hub for hydrogen and hydrogen-derived products. Most important, low-carbon technologies are finally coming of age. The need for many companies to replenish their ageing assets offers a “fast-forward mechanism”, says Per-Anders Enkvist of Material Economics.

Taken together, these developments are allowing industrial firms that have vowed to become carbon-neutral by 2050, which is to say many of them, to start putting money where their mouth is. Material Economics has identified 70 projects in Europe that are commercialising technology to reduce carbon emissions in basic-materials industries. Scarcely a week goes by without the unveiling of a new venture. Decarbonising industry has turned from mission impossible to “mission possible”, says Adair Turner of the Energy Transitions Commission, a think-tank.

The steel industry is the furthest along. H2GS’s mill in Boden is cleverly combining proven technologies at a big scale. The firm is building one of the world’s largest electrolysis plants to produce hydrogen. The gas is then pumped into a reactor, where it powers a process called “direct reduction”: under great heat, it snatches oxygen from iron ore, producing nothing but water and sponge iron. This material, so called because its surface is riddled with holes, is then refined into steel using an electric-arc furnace, which dispenses with coking coal.

A half-hour drive south of Boden, HYBRIT—a joint venture between SSAB, a steelmaker, Vattenfall, a power utility, and LKAB, an iron-ore producer—is piloting a similar process. In July the board of Salzgitter, a German steel company, gave the nod to a €723m project called SALCOS that will swap its conventional blast furnaces for direct-reduction plants by 2033 (it will use some natural gas until it can secure enough hydrogen). Other big European steel producers, including ArcelorMittal and Thyssenkrupp, have similar plans.

Cement-makers are heading in the same direction, albeit more slowly. Heating limestone generates about 60% of the sector's carbon emissions and a replacement technology, such as direct reduction in steelmaking, is lacking. So the industry is focusing on abating emissions after the fact, using carbon capture and storage (CCS). Many firms are experimenting with a heating process that replaces air with pure oxygen, which produces CO₂ suitable for sequestration. Some are trying to use electricity rather than fossil fuels to heat the limestone. The most ambitious are developing new, lower-carbon types of cement.

HeidelbergCement, the world's fourth-largest manufacturer of the stuff, has launched half a dozen low-carbon projects in Europe. They include a CCS facility in the Norwegian city of Brevik and the world's first carbon-neutral cement plant on the Swedish island of Gotland. Ecocem, an Irish startup, is making cement that uses less clinker, the intermediate material derived from the heated limestone, and thus emits less carbon. Some companies are trying to retrieve cement from old concrete in demolished buildings.

The chemicals industry faces the biggest challenge. Although powering steam crackers with electricity instead of natural gas is straightforward in principle, it is no cakewalk in practice, given the limited supply of low-carbon electricity. Moreover, the chemicals business breathes hydrocarbons, from which many of its 30,000 or so products are derived.

Even so, it is not giving up. BASF, a chemicals colossus, is working with two rivals, SABIC and Linde, to develop an electrically heated steam cracker for its town-sized factory in Ludwigshafen. It wants to make its site in Antwerp net-zero by 2030. To achieve this goal, BASF recently bought part of a wind farm off the Dutch coast to provide it with carbon-free electricity. The company is, like its cement counterparts, also taking a serious look at recycling, in particular a process called pyrolysis, where plastic waste is burned in the absence of oxygen and split into its hydrocarbon components. Other firms are dreaming up different types of greener feedstocks. AFYREN, a French startup, is deriving chemical building blocks from agricultural by-products instead of petroleum.

A few dozen pilot projects—even large ones—do not amount to a green transition. The hard part is scaling them up. The necessary infrastructure is either a work in progress (clean-electricity generation) or scarcely exists (hydrogen production and distribution). Costs remain high: green steelworks are still two to three times more expensive to build than the conventional kind. Attracting workers can be difficult, especially to renewables-rich places which are often, like Boden, remote. And rivals in other countries aren't standing still; a couple of giant Indian conglomerates in particular are betting big on green hydrogen. Europe needs to hurry up if it is to maintain its lead, warns Frank Peter of Agora Energiewende, a think-tank.

All these are real obstacles. But they need not be insurmountable ones. To understand why, once again consider H2GS. It has convinced firms including BMW, a carmaker, and two white-goods manufacturers, Electrolux and Miele, to sign contracts for 1.5m tonnes of green steel. That order book serves as collateral for banks to finance two-thirds of the project (with the rest coming from equity investments by backers including venture-capital firms and industrial giants such as Scania and Mercedes-Benz).

To attract hundreds of skilled workers and their families to remote Boden, meanwhile, it will help them find housing in a complex that will, if its architects have their way, resemble a snazzy resort. To secure the other important input, hydrogen, H2GS has teamed up with Iberdrola, a Spanish energy firm, to build a large factory in western Europe to produce the gas, with a view to supplying some of it to other industrial users.

H2GS's thinking is that if it can establish its steel and hydrogen platforms early, it can lock in important advantages ahead of competitors elsewhere. These include setting standards and grabbing a slice of potentially lucrative businesses such as software to control hydrogen- and steelmaking equipment. For Europe to become a green-industry superpower, its governments and industrial giants will need to display similar ingenuity and ambition. ■



绿色工业化

欧洲能让它的重工业脱碳吗？

能，但并不容易

瑞典钢材被认为是全世界强度最高的钢材。它或许很快还会成为最环保的。在北极圈附近的博登镇（Boden），一家名为H2 Green Steel（H2GS）的创业公司正在盖一座造价40亿欧元（40亿美元）的工厂，这是欧洲近半个世纪以来首次新建钢铁厂。它的用电将不再来自常规的煤或天然气，而是利用当地丰富的风能和水力生产的绿色氢气。这座钢铁厂将在几年后全面建成，届时会雇用多达1800名员工，每年生产500万吨钢铁。

该项目的影​​响远远超越人口稀少的瑞典北部。它可能给欧洲的钢铁和其他基础材料（比如水泥和化工产品）生产商带去重大的影响，这些厂商的直接产出合共占到欧盟GDP的1%左右。它还将沿供应链影响从汽车制造商到建筑商的一众企业，而根据智库Material Economics的数据，这些企业又另外贡献了欧盟产出的14%。它将提升欧洲的能源自主——俄罗斯为反制因乌克兰战争受西方制裁而用能源来胁迫已经凸显了这一点的重要性。鉴于基础材料行业的温室气体排放量约占欧洲的五分之一，它还会是气候的福音。简而言之，比尔·盖茨资助的风险投资基金突破能源（Breakthrough Energy）的安·梅特勒（Ann Mettler）认为，该项目标志着欧洲重工业在后化石燃料时代的复兴。

长期以来，重工业是碳密集型产业这一点似乎无法改变。炼钢中的铁矿石还原、水泥生产中的石灰石加热，以及利用蒸汽将碳氢化合物裂解成小分子等等工艺都需要耗费大量的能源。除此之外，其中涉及的化学过程还会再释放出大量二氧化碳。专家们一度认为，削减所有这些排放要么在技术上不可行，要么成本过高。

如今重工业脱碳似乎终于变得乐观起来，无论是在经济效益上还是技术上。欧洲正在引入更严格的碳排放目标，碳价格正在上涨，消费者也显示

出为更环保的产品支付更高价钱的意愿。就许多工业生产流程而言，氢最有可能成为化石燃料的替代品，为此好几个欧洲国家已经制定了氢战略。德国正在创设一个氢和氢衍生产品全球交易中心HINT.Co（全称Hydrogen Intermediary Network Company）。最重要的是，低碳技术终于走向成熟。Material Economics的珀-安德斯·恩夫特维斯特（Per-Anders Enkvist）表示，许多公司老化的资产需要更新换代，这提供了一种“快进机制”。

综合起来，这些进展让为数不少的誓言要在2050年实现碳中和的工业企业开始履行自己的承诺。Material Economics发现，欧洲有70个项目正在将基础材料行业的碳减排技术商业化。几乎每周都有这方面的新公司成立。智库能源转型委员会（Energy Transitions Commission）的阿代尔·特纳（Adair Turner）表示，工业脱碳已经从不可能的任务变成了“可能的任务”。

钢铁行业走得最远。H2GS在博登的工厂巧妙地大规模综合运用了不同的成熟技术。该公司正在建造世界上最大的电解设备之一来生产氢气。生产出的氢气被泵入反应器，为所谓的“直接还原法”提供动力：在高温下，它从铁矿石中夺取氧，只生成水和海绵铁（因其表面布满海绵样的小孔而得名）。然后使用电弧炉把海绵铁精炼成钢，这样就无需使用焦煤。

在博登以南半小时车程的地方，钢铁制造商SSAB、电力公司Vattenfall和铁矿石生产商LKAB组成的合资企业HYBRIT正在试验类似的工艺。7月，德国钢铁公司萨尔茨吉特（Salzgitter）的董事会批准了一项耗资7.23亿欧元的项目。这个名为SALCOS的项目将在2033年前把这家公司使用的老式高炉替换成使用直接还原法的设施（在获得足够的氢气之前，它会使用一些天然气）。包括安塞乐米塔尔（ArcelorMittal）和蒂森克虏伯（Thyssenkrupp）在内的其他欧洲大型钢铁生产商也有类似的计划。

水泥生产商也在朝着相同的方向行进，尽管速度要慢一些。该行业大约60%的碳排放来自石灰石加热，而且缺乏像炼钢中使用的直接还原法那样的替代技术。因此该行业正专注于使用碳捕获和封存技术（CCS）来补

救。许多公司正在试验一种用纯氧取代空气的加热方法，产生适于封存的二氧化碳。一些公司试图用电力而不是化石燃料来加热石灰石。最雄心勃勃的公司则在开发新型低碳水泥。

世界第四大水泥制造商海德堡水泥（HeidelbergCement）已经在欧洲启动了六个低碳水泥项目。其中包括位于挪威布雷维克市（Brevik）的CCS设施，以及位于瑞典哥特兰岛（Gotland）的全球首个实现碳中和的水泥厂。爱尔兰创业公司Ecocem正在生产一种少熟料水泥以减少碳排放，熟料是从加热的石灰石中提取的中间材料。一些公司正试图从已拆除建筑的旧混凝土中回收水泥。

化工行业面临的挑战最大。尽管用电力替代天然气为蒸汽裂解装置提供动力理论上并不复杂，但鉴于低碳电力供应有限，实践起来绝非易事。而且化工行业严重依赖碳氢化合物，它的大约三万种产品中许多都使用这类原料。

即便如此，该行业也没有放弃。德国化工巨头巴斯夫（BASF）正与两家竞争对手——沙特基础工业公司（SABIC）和林德（Linde）合作，为其位于路德维希港（Ludwigshafen）的规模相当于一个城镇的工厂开发一种电加热蒸汽裂解装置。该公司希望到2030年能让自己在比利时安特卫普的工厂实现净零排放。为此它在不久前收购了荷兰海岸附近的一座风力发电场的一部分，为自己提供无碳电力。与那些水泥公司一样，巴斯夫也在认真考虑如何回收利用，特别是用一种叫作热解的方法，即在无氧的情况下燃烧塑料垃圾，并将其分解为构成它的碳氢化合物。其他公司正在构想其他类型的更环保的原料。法国创业公司AFYREN正在从农副产品而不是石油中获提取化工原料。

几十个试点项目不足以实现绿色转型，即使它们是大型项目。困难在于如何把试点推广开来。必要的基础设施要么还在建设中（清洁发电），要么几乎不存在（氢气生产和配送）。成本仍然高居不下：环保钢铁厂的造价仍然是传统钢铁厂的两三倍。如何吸引到员工可能也是个难题，特别是像博登这样可再生能源丰富的地点往往都地处偏远。而且其他国家的竞争对

手也没有止步不前，尤其是印度的几家巨头企业集团正在绿色氢能上押下重注。智库Agora Energiewende的弗兰克·彼得（Frank Peter）警告说，如果欧洲想保持领先地位，就必须快马加鞭。

所有这些都是实实在在的障碍，但不一定克服不了。不妨再看看H2GS的例子。它已经说服一些公司签署了150万吨环保钢材的合同，包括汽车制造商宝马以及两家白色家电制造商伊莱克斯和美诺（Miele）。这笔订单作为银行抵押品，为该项目筹集到了三分之二的资金，其余则来自股权投资，投资者包括风险投资公司以及斯堪尼亚（Scania）和梅赛德斯-奔驰等工业巨头。

与此同时，为了吸引数百名技术工人及其家人来到偏远的博登，H2GS将帮助他们入住一个建筑群，如果建筑师尽情发挥，这个住宅区会被打造得像一个风景优美的度假胜地。为了确保另一种重要的投入品——氢气的供应，H2GS已经与西班牙能源公司伊比德罗拉（Iberdrola）合作，在西欧建立了一家大型氢气生产厂，这样还可将部分氢气供应给其他工业用户。

H2GS的想法是，如果能尽早建立自己的钢铁和氢气平台，它就能稳稳占据领先于其他地区竞争对手的重要优势。这包括制定标准，并在利润可能非常丰厚的业务中分得一杯羹，比如控制制氢和炼钢设备的软件。欧洲要想成为绿色工业的超级大国，其政府和工业巨头需要展现出与之匹配的创造力和雄心。■



Mothering invention

China and the West are in a race to foster innovation

Which will have more success?

“CHINA’S GOVERNMENT is planning on winning the AI race, winning future wars and winning the future,” warned Todd Young, an American senator, in July. “At stake” in the West’s technological competition with China, echoed a report from American officials and businessmen in September, “is the future of free societies, open markets, democratic government, and a world order rooted in freedom not coercion.” Earlier this month the head of a British intelligence agency joined the chorus, urging “deep investments” in new technology to counter China’s growing prowess.

The anxiety is easy to understand. In 2008 China spent a third as much as America did on research and development (R&D) and about half as much as Europe, after adjusting for differences in the cost of living. By 2014 it had surpassed Europe. By 2020 its spending was 85% of America’s.

The fruits of this investment are becoming apparent: in August a Japanese research institute calculated that China now produces more of the world’s most highly cited academic research than America does. Since 2015 more patents have been issued in China than in America. China’s output of a basket of sophisticated goods including information technology, pharmaceuticals and electronics is expected to surpass America’s this year, according to a report published by the Information Technology and Innovation Foundation, an American think-tank. “China has become a serious competitor in the foundational technologies of the 21st century,” concluded another report last year from the Belfer Centre at Harvard University.

Small wonder, then, that Western countries are embarking on a frantic

effort to retain or regain their technological edge. On October 7th America issued fierce new restrictions on exports to China of advanced semiconductors and related equipment. The new rules could be as crippling to the Chinese chip industry as previous American sanctions were to Huawei, a Chinese telecoms firm, says Greg Allen, who used to head the artificial-intelligence (AI) unit at America's Department of Defence. "It's a total clamp down, trying to cut off every head of the hydra of China's chip industry."

As well as trying to disrupt the flow of technology abroad, America's government is investing more in innovation. In August Congress approved \$370bn of spending on green energy, including lots of money for research. The month before it passed the Chips and Science Act, which provides \$52bn over five years for the semiconductor industry, some of which will incentivise private R&D.

The act also revamps the National Science Foundation (NSF) to put more emphasis on applied science and technology and potentially doubles its funding. Germany, Japan and South Korea are making multi-billion-dollar investments in computer chips. Last year Britain announced the \$1bn Advanced Research and Invention Agency (ARIA) to supercharge high-risk, high-reward science.

The result of all this is a global boom in investment in innovation. In 2020 the world's spending on R&D exceeded \$2.1trn, over 2.5% of global GDP, a record. The binge has three notable features. The first is the heavy involvement of governments, which are unwilling to leave investment to capital markets and are instead both funding R&D and subsidising production of certain high-tech goods. Both China and the West explicitly link such spending to geopolitical competition. "Technological innovation has become the main battlefield of the international strategic game," said China's president, Xi Jinping, in a speech last year to Chinese scientists.

“We’re in a multi-generation era-defining competition against the CCP [Chinese Communist Party],” rhymes Mr Young, one of the sponsors of the Chips Act.

The second feature of the new era is experimentation with different types of funding that couple industrial policy with efforts to promote risk-taking or private-sector rigour. America and Britain, for instance, are reviving research missions akin to America’s cold-war quest to put a man on the Moon. China, meanwhile, is using “guidance funds”, in which the state takes a stake alongside private investors, to steer money to startups in AI and chips, among other advanced technologies.

Third, governments are trying to ensure their country captures more of the benefits of innovation. That can mean both preventing exports of some goods and using industrial policy to promote domestic production.

But there remain big differences in approach between China and the West—most notably the far more muscular role the state still plays in directing innovation in China to favoured industries. The West, in contrast, relies on a more diffuse network of universities, non-profits and private businesses that have more freedom to set their own priorities. There is little doubt that China’s system has helped it catch up with the West in some existing technologies, but analysts question whether it will be as good at generating future breakthroughs. The answer will determine the outcome of the global battle for technological dominion.

America’s government invested lavishly in innovation during the cold war, through such organisations as the NSF and the Defence Advanced Research Projects Agency (DARPA). Its spending peaked at 1.86% of GDP in 1964. But after the fall of the Berlin Wall federal spending on R&D fell well below 1% of GDP. Private investment, meanwhile, doubled from 1% of GDP in 1979 to 2% in 2017. Giant tech firms such as Google, Facebook (now Meta), Amazon

and Apple sprouted in America. China spawned similar titans, such as Alibaba, Baidu, JD.com and Tencent.

But on both sides of the Pacific the age of free-flowing private capital left many disappointed. The Communist Party has called the spread of big consumer-tech firms a “disorderly expansion of capital”. It has obliged China’s internet giants to follow its priorities, blocking share sales and issuing abrupt regulations to cow wayward firms. It seems to want less video-gaming and online commerce and more AI, chips and green tech.

Many Americans have similar misgivings. Peter Thiel, a fabled investor, has argued that there has been too much investment in “bits” (software and analytics) and not enough in “atoms” (hardware and manufacturing). “With chips we were caught behind the eight ball,” says Eddie Bernice Johnson, a Democrat from Texas who chairs the committee that drafted the Chips Act, “It was a national security imperative.” Mr Young of Indiana agrees: “The totally free-market theories of Friedman, Hayek—they don’t make sense when you’re facing an existential threat that plays with market forces.”

| *Buying breakthroughs*

To allow a proper comparison of the sums devoted to innovation on the two sides of the Pacific, The Economist has totted up corporate spending on R&D, venture-capital investment, direct government funding and, for advanced technologies, implicit funding through subsidies, and subtracted the overlap among these categories. This calculation confirms that America maintains a slight edge (see chart 1), spending about \$800bn or 3.8% of GDP in 2020. That compares to about \$660bn in China after adjusting for differences in the cost of living, or 2.7% of GDP.

But China’s spending is growing far quicker than the West’s. China’s investments are also more co-ordinated. Although its government and America’s both directly dispense only about 15-20% of their country’s

expenditure on innovation, state-owned enterprises and industrial subsidies massively increase the influence of the state in China (see chart 2). Different arms of government have also set up nearly 2,000 “guidance funds” in which the state invests alongside private capital. The Chinese government began investing in semiconductors in this way as early as 2014, with a \$20bn “Big Fund”. The second iteration of the fund has raised nearly \$30bn. The state is now China’s biggest investor in venture-capital and private equity, contributing over 30% of the total.

All this allows the government to steer money towards its goals, in what is called *juguo tizhi* or the “whole-of-the-nation system”. Whereas in America the share of VC devoted to strategic industries as defined by the Belfer Centre report (AI, semiconductors, biotech, energy and quantum computing) has gradually grown from 10% to 20% over the past decade, in China it soared from 15% in 2019 to 35% in 2020 in line with government directives (see chart 3).

Yutao Sun and Cong Cao, two Chinese academics, argued in *Nature* last year that *juguo tizhi* had helped develop “a few state-led sectors with clear goals, such as high-speed rail and large passenger aircraft”. It was less effective, however, in “areas where there is no leader to follow”. Only 6% of China’s R&D spending is on basic research, compared with 17% of America’s.

What is more, *juguo tizhi* can also lead to misallocation of funds. A paper published in the journal *Econometrica* in July suggests that Chinese spending on R&D spurs less growth in productivity than that of neighbouring Taiwan. That is in part because the state often supports SOEs, even if they are less productive. Several studies suggest that corporate R&D in China is about half as productive as in America (although they do not focus exclusively on advanced technology).

America’s expenditure, meanwhile, is much more diffuse. Private

businesses account for about 60%, venture capital for nearly 20% and foundations, charities and universities more than 5%. In a recent presentation, Pierre Azoulay, a professor at MIT, notes that the “Cambrian explosion of philanthropic funders” is a “silver lining” compared with the perceived sclerosis in government funding. From 2010 to 2019, research funding from non-profits nearly doubled, from \$12bn to \$22bn. “Our system is unique because its more distributed and bottom-up; not top-down,” says Maria Cantwell, another senator.

America may also be more daring in its investments. The Institute for Progress (IFP), an American think-tank, is helping government agencies distribute grants more effectively, says Caleb Watney, a co-founder. Erwin Gianchandani of the NSF cites “golden tickets” as an example. Rather than the standard consensus-based process to allocate funding, a single reviewer can champion a project.

Michael Lauer, head of extramural research at America’s National Institutes of Health (NIH), lists a handful of new programs where labs receive funding with far fewer strings attached than normal. The Other Transactions Authorities, a recent NIH program that quickly funds unconventional projects, disbursed over \$2bn in 2020 and 2021.

| *Hunting for lightbulbs*

America is also creating more “moonshot” programs in an effort to replicate the success of DARPA. Last year it launched the \$1bn Advanced Research Projects Agency for Health (ARPA-H) to focus on ambitious biomedical research. The total amount of funding in this category increased from about \$4bn in 2021 to nearly \$6bn in 2022. Tom Kalil of Schmidt Futures, another organisation that aims to shape policy on innovation, says this heralds a shift towards more risk-taking. China lacks any equivalent funding agencies, notes Mr Cao of Nottingham University China.

It is possible to exaggerate the strengths of both the American and Chinese systems. For all the talk of moonshots, notes a former White House official, NIH was still slow to fund research on covid-19 at the beginning of the pandemic. And researchers are still often buried in paperwork. The new funding does little to address the administrative burden in the current system—researchers lose about 40% of their time to that, notes Tony Mills of the American Enterprise Institute, another think-tank. By the same token, although thousands of new firms have sprung up in China in favoured industries, such as AI and semiconductors, most of them do not seem to have achieved much.

Neither system has a monopoly on results. According to a report published in September by the Special Competitive Studies Project, a research group organised by Eric Schmidt, a former CEO of Google (and a former member of the board of The Economist), China is dominant in some industries, such as 5G telecoms. It makes some 80% of the world's lithium batteries. But the West is ahead on biotech, cloud computing and AI. It has been the source of most fundamental advances in these fields, such as CRISPR (a gene-editing technology) and the transformer architecture that underpins many big AI models.

Although few advanced computer chips are made in America, American firms tend to design them. ASML, a Dutch manufacturer of chipmaking equipment, has a monopoly in the advanced lithography needed to make the fanciest ones. And the Chips Act is prompting Intel and TSMC, two of the biggest chipmaking firms, to build new semiconductor fabs in America. Intel is also set to spend nearly \$20bn on new chip factories in Germany.

China has built first-rate AI models by throwing money at researchers and firms. Wu Dao, its version of GPT-3, an American AI model that can write like a human, uses ten times more parameters to train itself. Yet the chips used for much of this sort of machine-learning, GPUs, were originally

developed to generate graphics for video games—one of the industries on which the Chinese government has cracked down most ferociously. By the same token, it was not until September that a Chinese firm developed a vaccine against covid-19 that is as effective as Western ones—a recent high-stakes test of its capacity to innovate. “China does best in products where manufacturing is complex but the science is mature, for example in batteries,” says Dan Wang, an analyst at Gavekal Dragonomics, a research group.

But China is trying to mend some of the failings of its system. It boosted funding for basic research by 16% last year, in an attempt to foster more breakthrough discoveries. It is also trying to reduce centralisation. In July the party announced new rules to increase scientists’ autonomy. “There is evidence that China has recognised the limits of using a blunt metric to evaluate scientists,” adds Mr Wang. “Thus universities are starting to move towards the peer-review system of the West.”

There are some mistakes, however, from which China shows little sign of retreating. Mr Xi’s decision to rein in the tech industry contributed to an 11% contraction in venture-capital investment from the first three quarters of 2019 to the same period in 2022. In America VC investment grew by 70% in that time. China’s stubborn zero-covid policy, meanwhile, is driving foreign capital and talent out of the country. A survey by the German Chamber of Commerce in May found that nearly a third of foreign workers plan to leave.

Such talent is crucial to competitiveness. In the past China benefited from both foreign investment and large cohorts of “sea turtles”, students and researchers who work or study abroad and later return. The share of Chinese students studying abroad who eventually returned home rose from 25% in 2004 to 65% in 2019. And from 2015 to 2019, the number of academic papers published involving co-operation between American and

Chinese researchers grew by over 10% a year, according to Nature.

Yet in 2020 this growth in academic collaboration between the two countries abruptly stalled. Less than half as many Chinese received visas to study abroad in the first half of 2022 as in the first half of 2019. This pulling apart is bad for the world, but China may suffer more. It does not have as diverse a pool of researchers as the West. According to data from MacroPolo, a think-tank, although 60% of the world's best AI researchers work in America, over two-thirds of them are foreign (and over a quarter of them Chinese). In contrast, China draws overwhelmingly on domestic talent: almost all its best AI researchers are Chinese, and 70% of them have studied only in China.

America is not only open to foreign expertise, it also benefits from a big network of alliances with other technologically advanced countries. Collectively, America, Britain, France, Germany, Japan and South Korea spend over twice as much on R&D as China. China, by contrast, has few allies, and none that are powerhouses of research and innovation.

| *Bulbs blown*

American politicians do not seem to understand the advantage conferred by their country's openness, however. The original draft of the Chips bill included a provision to boost skilled immigration. Although some politicians, including Mr Young, gave it cautious support, it had to be removed to ensure the support of more Republicans, in particular. (America's allies, happily, are doing better. Britain has devised a scheme to provide visas to graduates of top universities. Australia and Canada, already home to lots of immigrants, are increasing immigration further.)

Whatever the limits to America's openness, however, China's growing isolation—both self-imposed and enforced by restrictions like America's new rules on tech exports—is far more severe. After several years when its

technological rise seemed unstoppable, the outlook suddenly seems much less clear. In the coming days Mr Xi will preside over China's 20th Party Congress. Across the Pacific, America's Congress will be debating how much money to devote to the new research initiatives at agencies like the NSF. You can be sure each will be on the other's mind. ■



培育创新

中国和西方正在竞相促进创新

谁会更成功？【深度】

“中国政府志在赢得AI竞赛，赢得未来的战争，赢得未来。”美国参议员托德·杨（Todd Young）在7月警告说。美国官员和商界人士在9月共同推出的一份报告中发出了类似的警告，称西方与中国的技术竞赛“攸关自由社会、开放市场、民主政府和根植于自由而非胁迫的世界秩序的未来”。本月稍早时，一家英国情报机构的负责人表达了同样的担忧，敦促“深度投资”新技术以对抗中国日益增长的实力。

这种焦虑不难理解。2008年，在调整生活成本差异后，中国在研发上的支出是美国的三分之一，欧洲的一半左右。到2014年，中国的研发支出已超过欧洲。到2020年，它的支出是美国的85%。

这项投入的成果日益显现。8月，日本的一家研究机构计算得出，中国如今发表的高引科研论文数量高于美国。自2015年以来，中国授予的专利数量多过美国。根据美国智库信息技术与创新基金会（Information Technology and Innovation Foundation）发布的一份报告，今年中国的信息技术、药品和电子产品等一揽子高精尖商品的产量预计将超过美国。“中国已成为21世纪基础技术的重要竞争对手。”哈佛大学贝尔弗中心（Belfer Centre）去年发布的另一份报告总结道。

难怪西方国家着急忙慌地要维持或夺回技术优势了。10月7日，美国就对华出口先进半导体及相关设备出台了严厉的新限制措施。曾担任美国国防部人工智能部门负责人的格雷格·艾伦（Greg Allen）表示，新规则对中国芯片行业的打击可能堪比美国之前对中国电信公司华为的制裁。“这是一场全面压制，要的就是不给中国芯片行业任何翻身的机会。”

除了力图中断向国外的技术流动，美国政府还在加大对创新的投资。8月，国会批准了3700亿美元的绿色能源支出，其中包含大量研发资金。再

往前一个月国会通过了《芯片和科学法案》（Chips and Science Act），将在五年内为半导体行业提供520亿美元资金，其中一些将用来激励私营部门研发。

该法案还将改革国家科学基金会（NSF），更加重视应用科学和技术，还有可能把给它的拨款翻倍。德国、日本和韩国都在对各自的计算机芯片业投入数十亿美元计的资金。去年，英国宣布投入10亿美元成立高级研究和发明局（Advanced Research and Invention Agency, ARIA），以大力扶持高风险、高回报的科研工作。

这一切掀起了全球创新投资的热潮。2020年，全球研发支出超过2.1万亿美元，占全球GDP的比例超过2.5%，创历史新高。这股热潮有三个显著特征。首先是政府大力参与，它们不愿把投资交由资本市场，而选择既为研发注资，又为某些高科技产品的生产提供补贴。中国和西方都明确将此类支出与地缘政治竞争联系起来。“科技创新成为国际战略博弈的主要战场。”中国国家主席习近平去年对中国科学家讲话时说。“我们正在与中国共产党进行一场需要几代人参与的划时代竞争。”《芯片法案》的发起人之一杨说。

新时代的第二个特点是尝试不同类型的注资方式，将产业政策与推动冒险或更严格管控私营部门结合起来。例如，美国和英国正在恢复类似于美国冷战时期将人类送上月球的研究项目。与此同时，中国正在利用“政府引导基金”（政府与私人投资者一起投入），将资金导向AI和芯片等先进技术领域的创业公司。

第三个特点是各国政府正努力确保本国从创新中获得更多收益。这可能意味着既要阻止某些商品的出口，又要利用产业政策来促进国内生产。

但中国和西方的做法仍有大不同。最明显的差异是，在中国，政府在引导受其青睐的行业创新上扮演的角色仍要强力得多。相比之下，西方依赖由高等院校、非营利机构和私营企业组成的更分散的网络，这些组织有更多的自由来设定自己的优先项。毫无疑问，中国的体制帮助它在一些现有

技术上赶上了西方，但分析人士质疑它是否能同样有效地带来未来的突破。这个问题的答案将决定全球争夺科技主导权之战的结果。

冷战期间，美国政府通过NSF和国防部高级研究计划局（DARPA）等机构大举投资创新。这部分支出在1964年达到峰值，占到GDP的1.86%。但在柏林墙倒塌后，联邦研发支出降至远低于GDP的1%。与此同时，私人研发投入占GDP比例从1979年的1%翻倍至2017年的2%。谷歌、Facebook（现在的Meta）、亚马逊和苹果等大型科技公司在美国如雨后春笋般涌现。中国也诞生了阿里巴巴、百度、京东和腾讯等类似的巨头企业。

但在太平洋两岸，私人资本自由流动的时代都让许多人感到失望。共产党称大型消费科技公司的扩张是“资本的无序扩张”。它迫使中国的互联网巨头遵循它的政策导向，阻止股票发行，并突然发布法规来威吓恣意发展的公司。共产党似乎希望科技企业减少对电子游戏和在线商务的投入，更多地发展AI、芯片和绿色技术。

许多美国人也有类似的疑虑。被封神的投资者彼得·蒂尔（Peter Thiel）认为在“位元”（软件和分析）方面的投资过多了，而在“原子”（硬件和制造）方面的投资不足。“我们先前在芯片方面处境不利，”来自得克萨斯州的民主党人、在起草芯片法案的委员会任主席的埃迪·伯尼斯·约翰逊（Eddie Bernice Johnson）说，“这曾是关乎国家安全的紧迫问题。”印第安纳州的参议员杨对此表示赞同：“当你面对的是一个玩弄市场力量的生存威胁时，弗里德曼、哈耶克的完全自由市场理论就没有意义了。”

| 花钱买突破

为了合理比较中美创新投入的资金总量，本刊将企业研发投入、风险资本投资、政府直接拨款以及先进技术方面的隐性补贴注资加总，然后减去这些类别之间重叠的部分。计算结果证实美国保持着微弱领先（见图表1），2020年在创新方面的支出约为8000亿美元，占GDP的3.8%。相比之下，在调整生活成本差异后中国的支出约为6600亿美元，占GDP的2.7%。

但中国的支出增速远快于西方。中国的投资也更加多方协同运作。尽管

中美政府都只直接拨发了国家创新支出的约15%至20%，但在中国，国有企业和产业补贴大大增加了政府的影响力（见图表2）。政府各部门还设立了近2000支“引导基金”，由国家与民间资本共同投资。中国政府早在2014年就开始以这种方式投资半导体行业，设立了一支“大基金”，募集了200亿美元，二期筹集了近300亿美元。政府现在是中国最大的风险投资和私募股权投资方，占投资总额的30%以上。

所有这些都让政府能够将资金引向其目标行业，这就是它的“举国体制”。在美国，贝尔弗中心的报告中所列出的战略行业（AI、半导体、生物技术、能源和量子计算）获得的风险投资占比在过去十年里从10%逐渐增长到20%。而在中国，在政府指令的带动下，这一比例在2019年到2020年的一年间从15%一举飙升到35%（见图表3）。

两位中国学者孙玉涛和曹聪去年在《自然》杂志上发表文章指出，举国体制帮助发展了“高铁和大型客机等几个目标明确、由国家主导的行业”，而在“没有人牵头的领域”，该体制效果较逊色。中国只有6%的研发支出投向基础研究，而美国的这一比例为17%。

此外，举国体制也可能导致资金错配。7月发表在《计量经济学》（Econometrica）期刊上的一篇论文表明，与中国台湾相比，中国大陆的研发支出对生产率增长的推动作用更小。原因之一是政府往往支持国有企业，即使它们的生产率更低。有几项研究表明，中国企业研发的效益大约是美国的一半（尽管企业并非完全专注于先进技术）。

与此同时，美国的支出要分散得多。私营企业约占60%，风投占近20%，基金会、慈善机构和大学占5%多一些。麻省理工学院的教授皮埃尔·阿祖莱（Pierre Azoulay）在近日一次演讲中指出，与外界看来僵化的政府资助相比，“慈善资助机构寒武纪大爆发式的增长”是“一线希望”。从2010年到2019年，来自非营利机构的研究资金几乎翻了一番，从120亿美元增加到220亿美元。“我们的体制独一无二，因为它更多是分布式和自下而上，而不是自上而下的。”另一位参议员玛丽亚·坎特威尔（Maria Cantwell）说。

美国在投资方面可能也更加大胆。美国智库进步研究所（Institute for Progress, IFP）正在帮助政府机构更有效地分配经费，该所的联合创始人卡莱布·沃特尼（Caleb Watney）说。NSF的埃尔文·詹坎达尼（Erwin Gianchandani）举了“金票制”的例子。与一般基于共识的资金分配流程不同，一个项目只需一名审核人同意便可获得拨款。

美国国立卫生研究院（National Institutes of Health, NIH）院外研究主任迈克尔·劳尔（Michael Lauer）列举了一些新获批的项目，实验室在拿到资助时所要满足的条件比正常情况下少得多。其他交易授权（Other Transactions Authorities）是NIH近年实施的一个快速资助非常规项目的计划，在2020年和2021年拨款超过20亿美元。

| 寻找灯泡

美国也在创建更多的“登月型”项目，以复制DARPA的成功。去年它投入10亿美元启动了卫生高级研究计划局（Advanced Research Projects Agency for Health, ARPA-H），专注雄心勃勃的生物医学研究。这一领域的研究资金总额从2021年的约40亿美元增加到了2022年的近60亿美元。另一家旨在影响创新政策的机构施密特未来（Schmidt Futures）的汤姆·卡利尔（Tom Kalil）表示，这预示着朝着更多冒险的转向。中国缺乏同类的资助机构，宁波诺丁汉大学的曹聪指出。

美国和中国体制的优势都有可能被夸大了。一位前白宫官员指出，尽管大谈特谈要推动登月型项目，NIH在疫情爆发之初在资助新冠肺炎研究方面仍然动作迟缓。而且研究人员仍然经常要埋首于文书工作。新一轮拨款对解决现行体制中的行政负担几乎没有助益，而研究人员在这方面花费了约40%的时间，另一家智库美国企业研究所（American Enterprise Institute）的托尼·米尔斯（Tony Mills）指出。同样，尽管中国在AI和半导体等受青睐的行业涌现出成千上万家新公司，但大多数似乎并没有取得太大的成果。

两个体制在成果方面都没有形成垄断。由谷歌前首席执行官（也是《经济学人》前董事）埃里克·施密特（Eric Schmidt）组织的研究团体特殊竞

争研究项目（Special Competitive Studies Project）在9月发表的一份报告称，中国在5G通信等一些行业占据主导地位。中国生产的锂电池占全球产量的约80%。但西方在生物技术、云计算和AI领域领跑。在这些部门，西方带来了最根本性的进展，比如CRISPR基因编辑技术和支撑许多大型AI模型的transformer架构。

尽管先进计算机芯片基本不在美国生产，但往往由美国公司设计。荷兰芯片制造设备制造商阿斯麦（ASML）垄断了制造最精密芯片所需的先进光刻技术。《芯片法案》正促使英特尔和台积电这两家最大的芯片制造公司在美国开设新的半导体工厂。英特尔还将斥资近200亿美元在德国新建芯片工厂。

中国通过向研究人员和公司砸钱建立了一流的AI模型。中国版GPT-3（可以像人类那样写作的美国AI模型）“悟道”的训练参数是原版GPT-3的十倍。然而，大部分此类机器学习所用的GPU芯片最初都是为生成电子游戏图形而开发的，而电子游戏是受中国政府打击最严厉的行业之一。同样，直到9月，一家中国公司才开发出了一种与西方疫苗同样有效的新冠疫苗——这是对中国创新能力的新一次高风险测试。“中国在生产工艺复杂但科学已经成熟的产品方面做得最好，比如电池。”研究机构龙洲经讯（Gavekal Dragonomics）的分析师王丹（音译）说。

但中国正试图弥补其体系的一些缺陷。去年，它为基础研究增加了16%的资金，以期促进更多突破性发现。它还试图减少中心化。7月，党宣布了给予科研人员更大自主权的新规。“有证据表明，中国已经认识到使用生硬的指标来评估科学家的局限性，”王丹补充道，“因此，大学开始转向西方的同行评议制度。”

然而，在一些错误做法上中国几乎没有收手的迹象。习整顿科技行业的决定导致2022年前三个季度的风险投资比2019年同期收缩了11%。在此期间美国的风险投资增长了70%。与此同时，中国坚持实施清零防疫政策，正在把外国资本和人才推出国门。德国商会5月的一项调查发现，近三分之一的外国员工计划离开中国。

这样的人才对竞争力至关重要。过去，中国既受益于外国投资，也受益于大批“海归”（在海外留学或工作而后回国的学生和研究人员）。中国留学生的归国比例从2004年的25%上升到2019年的65%。《自然》杂志的数据显示，2015年至2019年，中美研究人员合作发表的学术论文数量每年增长超过10%。

然而在2020年，两国学术合作的增长突然停滞。2022年上半年获签证出国留学的中国人不到2019年上半年的一半。这种彼此疏远对世界不利，但中国可能损失更大。它没有西方那样多元化的研究队伍。根据智库MacroPolo的数据，尽管全球顶尖AI研究人员有60%在美国工作，但其中超过三分之二是外国人（这其中超过四分之一是中国人）。相比之下，中国主要依靠国内人才，它最优秀的AI研究人员几乎都是中国人，其中70%的人没有海外学习经历。

美国不仅对外国专家持开放态度，还受益于与其他科技强国的庞大联盟网络。美国、英国、法国、德国、日本和韩国在研发上的投入加起来是中国的两倍多。相比之下，中国盟友寥寥，且无一不是科研和创新强国。

| 灯泡烧坏

然而，美国的政客似乎并不明了自己国家的开放态度带来的优势。最初《芯片法案》的草案包含一项促进技术移民的条款。尽管包括杨在内的一些政客对此予以谨慎的支持，但为了获得更多支持，尤其是共和党人的支持，该条款不得被删除。（所幸的是，美国的盟友们做得更好。英国制定了一项向顶尖大学毕业生提供签证的计划。原本就移民众多的澳大利亚和加拿大正在进一步增加移民配额。）

然而，无论美国的开放受到何种限制，中国日益孤立的程度要严重得多——无论是自我孤立，还是由美国的技术出口新规等限制措施强加的孤立。有那么几年，中国的技术崛起似乎势不可挡，如今前景突然模糊了许多。未来几天里，习将主持召开中国共产党第二十次全国代表大会。在太平洋彼岸，美国国会将讨论为NSF等机构的新研究计划投入多少资金。可以确定的是，两边在开会时都会惦记着彼此。■



Crime, then punishment

As Europe falls into recession, Russia climbs out

Real-time data show a subdued but strengthening economy

THESE DAYS Russians do not have much to boast about, so they take what they can get. Social-media trolls are posting videos, intended for European audiences, showing gas stoves left on full blast. What might cost hundreds of euros in Berlin comes to a few roubles in Moscow. The taunting is childish, but it hints at a deeper truth: the economic war between Russia and the West is at a delicate moment. While Europe teeters on the brink of recession, Russia is emerging from one.

Western sanctions, launched in response to Vladimir Putin's invasion of Ukraine, have wounded Russia's long-term prospects. Blocking the world's ninth-largest economy from accessing foreign tech and expertise has cut its growth potential by as much as half, forecasts suggest. Output of oil and gas, the lifeblood of Russia's economy, is about 3% lower than before the invasion and may fall further once European embargoes come into effect at the turn of the year. In the first six months of the war between 250,000 and 500,000 Russians fled the country, reckons Liam Peach of Capital Economics, a consultancy. Lots were highly educated and well paid.

Mr Putin's recent decision to launch a partial mobilisation has dealt a further economic blow. It provoked a small bank run as people again worried about the future of the country. By our estimates Russians pulled out \$14bn-worth of rouble deposits in September, about a third as much as in February. Another 300,000 or so Russians have probably fled. A further reduction in the labour force is worsening shortages, and thus compounding inflation. Headline inflation is sharply down from its peak, but price pressure in the labour-intensive services sector is worsening.

Despite these problems, the recession has probably now come to an end. Many doubt official GDP data, but it is possible to get a sense of activity from a range of sources. Goldman Sachs, a bank, produces a “current-activity indicator”, which follows how economies are doing month to month. The data suggest Russian activity is livelier than in other big European countries (see chart). A spending measure produced by Sberbank, another bank, wobbled following the mobilisation decree but has since edged up. Output in the car industry, which a few months ago had practically fallen to zero, has also bounced back, suggesting producers have obtained supplies from outside the West. In dollar terms Russia’s monthly goods imports now almost certainly exceed last year’s average.

In its recent forecasts, the IMF upgraded Russia’s prospects for 2022. In April it thought that Russian GDP would fall by 8.5%. It now expects a decline of 3.4%. This is nothing to gloat about, but it is manageable. Indeed, the data suggest Russia will be able to maintain its military spending. In September the government put out a draft budget for 2023-25. According to Elina Ribakova of the Institute of International Finance, an industry group, it implies large increases in war-related spending in the coming years, particularly on internal “security”. Having avoided economic collapse, Mr Putin expects to double down, both abroad and at home. ■



罪后罚

欧洲跌入衰退之际，俄罗斯从谷底爬出

实时数据显示，俄罗斯经济虽受压制，但正在走强

如今俄罗斯人没多少东西可以炫耀，所以他们有什么就显摆什么。在社交媒体喷子发布的视频里，燃气灶的火力开到了最大，这自然是给欧洲人看的。在柏林可能要几百欧元的东西，在莫斯科只需要几卢布。这样的嘲弄很幼稚，但它透露出一个更深层的真相：俄罗斯和西方之间的经济战走到了一个棘手的时刻。欧洲徘徊在经济衰退的边缘，而俄罗斯正在摆脱萧条。

西方针对普京入侵乌克兰对俄罗斯发起制裁，损害了它的长期前景。预测显示，阻止世界第九大经济体获取外国技术和专业知识已将其增长潜力削弱了一半。作为俄罗斯经济命脉的石油和天然气的产量比入侵前下降了3%，一旦欧洲的禁运在岁末年初生效，可能还会进一步下降。据咨询公司凯投宏观（Capital Economics）的利亚姆·皮奇（Liam Peach）估计，在战争的头六个月里，有25万到50万俄罗斯人逃离了这个国家。其中很多人受过高等教育，收入很高。

普京近期决定发动局部动员，这进一步打击了经济。此举引发了一场小规模银行挤兑，因为人们再次对国家的未来感到担忧。据我们估计，俄罗斯人在9月提取了约合140亿美元的卢布存款，约为2月时的三分之一。可能又有30万左右的俄罗斯人逃离。劳动力进一步减少，加剧了短缺，令通胀问题更加麻烦。总体通胀率已从峰值大幅下降，但劳动密集型的服务业的价格压力越来越大。

尽管存在这些问题，但经济衰退可能正走向终结。许多人对官方GDP数据表示怀疑，但我们可以从各个不同的信息源一窥究竟。高盛制定了“当前活动指标”，追踪各个经济体每月的表现。数据显示，俄罗斯的经济活动比其他欧洲大国更活跃（见图表）。另一家银行俄罗斯联邦储蓄银行（Sberbank）发布的支出指标在动员令出台后出现了波动，但之后已小幅

上扬。几个月前几乎降至零的汽车业产出也已经反弹，表明生产商已经从西方以外的源头获得了供给。以美元计，俄罗斯目前每月的商品进口几乎肯定超过了去年的平均水平。

在最近的预测中，IMF上调了对俄罗斯2022年的经济预期。4月时它认为俄罗斯的GDP将下降8.5%。现在它的预测是下降3.4%。这样的降幅不值得沾沾自喜，但尚能应付。实际上，数据表明俄罗斯将有能力维持其军费开支。9月，俄政府公布了2023年至2025年的预算草案。行业组织国际金融协会（Institute of International Finance）的埃琳娜·雷巴科娃（Elina Ribakova）认为，这意味着未来几年与战争相关的支出将大幅增加，特别是在国内“安全”方面。经济崩溃既然已经避免，普京指望着在国外和国内都能重拳出击。 ■



Bartleby

The deadly sins and the workplace

Nobody's perfect. Managers should not forget that

THE ARC of current management thinking bends towards virtue. Co-operation is what makes teams purr. Low-ego empathy is the hallmark of a thoroughly modern boss. Purpose matters to employees as much as pay; society looms as large as shareholders. But appealing to people's better nature, and ignoring their vices, is an incomplete approach. Nor is being good necessarily great for your own career.

Take a look at the seven capital virtues and the seven deadly sins laid out in Christian tradition. The virtues are chastity, temperance, charity, diligence, kindness, patience and humility; the vices are lust, gluttony, greed, sloth, envy, wrath and pride.

In aggregate the first set of qualities is the one for managers to emulate. Neither chaste charity nor lustful gluttony have much to recommend them as a management ethos; but only one is a lawsuit waiting to happen. Diligence clearly beats sloth. Greed is out of fashion. Aiysha Dey of Harvard Business School and her co-authors have found that excessive materialism on the part of a chief executive can be a warning sign of fraudulent activity and out-of-control risk-taking. Pride is also increasingly seen as problematic: in a paper from 2018 academics identified narcissistic bosses by the size of their signatures and found a correlation with poor financial outcomes at the firms they ran.

Yet saintliness is rare and sinfulness can be underrated. Take envy, for example. By design organisations rely on competition as well as co-operation. A kind person might well be content to applaud other people for their success. An envious one will see someone to catch up with.

Psychologists distinguish between malign and benign versions of envy. In one, people try to close gaps in status by bringing others down. In the other, they are motivated to improve their own performance. A recent paper by Danielle Tussing of the University at Buffalo and colleagues discovered a third type of behaviour: people who skipped work or even quit their jobs in order to avoid feelings of envy. Understanding such emotions is a step towards harnessing them.

Pride can also lead to greater effort (as well as to gigantic signatures). In an elegant paper looking into the performance of German fighter pilots in the second world war, Philipp Ager of the University of Mannheim and other researchers found that personal rivalry fuelled risk-taking behaviour. When pilots received public recognition for their exploits in a daily bulletin to the German armed forces, peers with whom they had flown in the past redoubled their own efforts. Something propelled them to fly more missions, even though that meant a greater chance of being killed, and it wasn't humility.

Patience may be a virtue, but it is not always the best quality in a leader. Research on the impact of managers' moods on performance is pretty thin: one deeply unpersuasive paper from 2017 used facial-recognition software to analyse CEOs' TV appearances and concluded that expressions of anger and fear were associated with improved profitability in the following quarter. Yet forbearance can plainly go too far. Anyone who has worked in an office knows that the boss's wrath can sometimes be the only thing that gets things moving.

Greed is not something to admit to in polite society but acquisitiveness still motivates an awful lot of people. In their research into CEO behaviour Ms Dey and her co-authors defined excessive materialism as owning a private home worth twice as much as the median house in the area; owning a car worth more than \$75,000; or owning a boat that was longer than 25 feet. Of

her sample of CEOs, fully 58% ticked one or more of these boxes; only 42% counted as frugal.

Gluttony may not fuel ambition but it could well be a side-effect of the hierarchies that characterise companies. Research experiments in which strangers are assigned a high-status role and a low-status role and put in a room together have found that those placed in positions of authority help themselves to more biscuits than the others. Even people who mean well may end up behaving badly if they acquire power.

If management is about getting the best out of people, it helps to understand base behaviours as well as noble ones. Employees are humans and humans are complex. They seek to improve the world and would quite like their own swimming pool. They want to mentor the disadvantaged and see their rivals fail miserably. They grab the biscuits. ■



巴托比

七宗罪与职场

人无完人。管理者不应忘记这一点

如今的管理思想倾向于美德。合作让团队持续运作。放低自我、富有同理心是一个真正的新式老板的标志。使命感和薪酬对员工同样重要。社会责任和股东利益同等优先。但诉诸于人性的善而无视人性的恶的做法有所欠缺。品行高尚对个人的职业生涯也不一定有益。

来看看基督教传统中列出的七美德和七宗罪。美德分别是：贞洁、节制、慷慨、勤勉、宽容、忍耐和谦逊；罪行分别是：色欲、暴食、贪婪、懒惰、嫉妒、愤怒和傲慢。

总的来说第一组品质是管理者要努力看齐的。他们是克己助人，还是酒池肉林，都和管理理念关系不大，但容易惹上官司。勤勉显然胜过懒惰。贪婪已不受普遍认可。哈佛商学院的艾耶莎·戴伊（Aiyesha Dey）与她的合著者发现，CEO过度物质主义可能是欺诈或过分冒险的警示信号。傲慢也越来越被视为一个问题：在2018年的一篇论文中，学者们通过签名的大小来识别老板们是否自恋，并找到了这与他们经营的公司糟糕的财务状况之间的关联性。

然而，至善的圣人非常罕见，罪恶的作用可能被低估。比如嫉妒。组织的构建向来是既依赖合作，也依赖竞争。好人很可能乐于为他人的成功而鼓掌，有嫉妒心的人想着自己要迎头赶上。

心理学家将有害和无害的嫉妒做了区分。在前一种情况下，人们试图把别人拽下来以缩小与对方的地位差距。而在后一种情况下，人们受到激励去提升自己的表现。纽约州立大学布法罗分校（University at Buffalo）的丹妮尔·图斯（Danielle Tussing）及其同事最近撰写了一篇论文，他们发现了嫉妒的第三类行为表现：为避免感受嫉妒，人们会旷工甚至辞职。了解这些情绪有助于管理好它们。

傲慢可能让人写出硕大的签名，也可能让人加倍努力。德国曼海姆大学（University of Mannheim）的菲利普·阿格（Philipp Ager）和其他研究人员撰写了一篇精妙的论文，研究了二战中德国战斗机飞行员的表现。他们发现，个体之间的争强好胜激发了更多冒险行为。当飞行员的壮举在德国军队发布的每日公报中获得公开表彰时，曾与他们一起飞行的战友会加倍努力。有种力量驱使他们执飞更多的任务，即使这意味着阵亡的风险加大。这种力量可不是谦逊。

忍耐可能是种美德，但并不总是领导者的最佳品质。有关管理者的情绪对业绩的影响的研究还相当薄弱。在2017年发表的一篇论文中，作者使用面部识别软件分析了CEO在电视上的表情并得出结论：愤怒和忧惧的表情与下一季度利润率提升之间有关联。这非常缺乏说服力。但忍耐显然会走过头。每个职场人士都知道，老板的愤怒有时可能是唯一能推进工作的力量。

在上流社会中人们通常不承认自己贪婪，但占有欲仍然激励着一大批人。在对CEO行为的研究中，戴伊和其他作者对过度物质主义的定义是：拥有一套价值两倍于本地中位数的私人住宅；拥有一辆价值超过7.5万美元的汽车；或者一艘长度超过25英尺的船。在她调查的CEO样本中，有整整58%的人符合其中一项或多项；只有42%的人被划入节俭。

贪吃暴食或许不会激发雄心，但它很有可能是公司里司空见惯的等级制度的一个附带后果。研究人员做了一些实验，给一些素不相识的人分配了地位高低不等的角色，然后把他们安排在一个房间内。实验发现，处于权威地位的人给自己拿的饼干会比其他人多。即使是心怀善念的人，一旦获得权力，最终也可能做出低劣的行为。

如果管理是为了人尽其才，那么我们就不但要理解高尚的行为，也要理解卑劣的行为。员工都是人，而人是复杂的。他们力图改善世界，同时也不介意拥有自己的泳池。他们愿意帮扶弱势，也想看到自己的对手惨败。他们都是见到饼干就抢的自私人啊。 ■



Bartleby

The magic formula of management

Five numbers, one connecting idea

THIS IS THE age of the data scientist. Employers of all kinds prize people with the skills to capture and analyse enormous amounts of information, to spot patterns in the data and to turn them into useful insights. But some of the most valuable figures in business need neither an analytics team nor knowledge of Python. They are simple to remember and useful for bosses in every organisation. Here is a small selection of management's magic numbers:

Zero: Doing nothing can be the most valuable thing a manager can do, as the fable of Atwood's duck demonstrates. Jeff Atwood, a computer programmer, is credited with popularising the (possibly apocryphal) story of a piece of deliberately unnecessary work that an animator did on a video game called "Battle Chess".

Aware that the higher-ups needed to feel that they were adding value by making changes, the animator gave the character of the queen a wholly extraneous pet duck. Sure enough, the reviewers asked the programmer to do only one thing: remove the bird. In theory everyone ended up happy, except the duck. In practice time had been wasted because people higher up the chain needed to justify their existence.

One: This is the number of bosses people should have. In reality, matrix structures and team-based approaches mean that lots of workers report to multiple masters. According to a Gallup survey in 2019, 72% of American employees occasionally or consistently work in different teams. This approach can have benefits, but clarity is not one of them. The Gallup poll showed that those who work in a matrix are less likely to know what is

expected of them, and more likely to spend their day festering in endless internal meetings. Managers in matrix structures should at least try to make their underlings feel like they have one boss, even when they do not.

Three: In a paper published in 2013 two academics tested whether there was an optimal number of claims that marketers should make for their products and services in promotional messages. They found that making three claims was best: any fewer and consumers felt they lacked enough information to make their minds up about a product; any more and they became sceptical that the claims were authentic. The “rule of three” is useful in many other settings, too, from points in presentations to pricing options for customers. One place it does not apply is in a column about magic numbers, so:

Ten: The number of people who should be in a meeting depends not just on what is being discussed, but also on where it is taking place. According to a survey of British workers conducted in 2021 by Nicholas Bloom of Stanford University and Paul Mizen and Shivani Taneja of the University of Nottingham, the efficiency of online meetings declined steadily as the number of participants grew. Zoom calls work best with between two and four participants, when there is less need for people to keep muting and unmuting, more chance to see people’s facial expressions and less chat-room blather. Efficiency declines until ten people or more are involved, at which point it is better to hold meetings in person.

150: Dunbar’s number postulates that the number of stable social connections a human can have is roughly 150. First proposed by Robin Dunbar, an anthropologist at Oxford University, the figure has its critics. Some researchers reckon it is too low; introverts think it is ludicrously high. But this group size recurs in many settings, from the congregations of single-leader churches to networks of Christmas-card recipients. Companies have also found that it has significance; passing the 150-person

threshold requires a change in management practices, from informal and undocumented to structured and codified.

There is a pattern to these numbers. In one way or another, they illustrate the risks of addition. Expand a company beyond a certain size and social bonds will weaken. Invite more people to the meeting and you will wait longer at the start as everyone dials in. Add extra reporting lines and the burden of collaboration will spiral.

The idea that less is more is not new, of course. Max Ringelmann was a 19th-century French engineer who found that adding more and more people to a rope-pulling team had an adverse effect on individual productivity. The more people there were to tug on the rope, the less sense of responsibility each person felt for the outcome and the less hard they pulled. Ringelmann's insight is still valid. Subtraction has its attractions. ■



巴托比

管理学的神奇公式

五个数字一念穿

这是数据科学家的时代。各种各样的雇主都很看重那些能捕捉并分析海量信息、从数据中发现模式且将之转化为有用见解的人。但是商业中一些最有价值的数字既不需要分析团队也不需要人懂什么Python。它们简单好记，而且对每个组织的老板都有用。以下就是管理学的一组神奇数字。

0：无为而治可能是管理者的最高境界，就像“阿特伍德的鸭子”（Atwood's duck）相关的故事展示的那样。人们认为是电脑程序员杰夫·阿特伍德（Jeff Atwood）使得这个（可能是杜撰的）故事广泛流传，它说的是有一名动画师在制作一款叫“决战西洋棋”的电子游戏时故意放进了一个不必要的设计。

这位动画师意识到自己的上级会需要做些修改以显示自己在增加价值，于是给游戏中皇后这个角色配了一只完全违和的宠物鸭。果不其然，负责审核的上级只要求程序员做了一件事：把鸭子删掉。理论上皆大欢喜，除了那只鸭子。实际上却浪费了时间，只因上级需要证明自己存在的价值。

1：员工应该只有一个老板。在现实中，矩阵结构和以团队为基础的工作方式意味着许多员工要向多个上司报告。盖洛普（Gallup）2019年的一项调查显示，72%的美国员工不定期或始终在不同的团队工作。这种方式可能有其好处，但清晰明确不是其中之一。盖洛普的调查表明，在矩阵型公司工作的人更不容易知道公司对自己的期望是什么，更有可能把时间都花在没完没了的内部会议上。矩阵式结构中的管理者至少应该努力让下属觉得他们只有一个老板，即使实际不是如此。

3：在2013年发表的一篇论文中，两名学者测试了营销人员在促销信息中为其产品和服务设计的广告语是否存在一个最佳数量。他们发现，三条是最好的：少于三条，消费者会觉得信息不足，难以做出买不买产品的决

定；再多的话，他们就会怀疑这些话的真实性。“三条法则”在许多其他场合下也很有用，从演示中的要点数量到给客户的定价选项，等等。有一个地方不适用，那就是介绍神奇数字的专栏文章，所以请接着往下看。

10：参加会议的人数不仅取决于讨论的内容，还取决于会议的地点。斯坦福大学的尼古拉斯·布鲁姆（Nicholas Bloom）和诺丁汉大学的保罗·米森（Paul Mizen）、希瓦尼·塔内贾（Shivani Taneja）在2021年对英国员工进行的一项调查显示，随着参会人数的增加，在线会议的效率会不断下降。Zoom会议在两到四人参加时效果最好，这时人们不大需要不停静音又取消，有更多机会看到大家的面部表情，也没有那么多聊天室里的废话。人再多些，效率就开始下降，如果增加到10个人或更多就不如举行线下会议了。

150：这是邓巴数字，即认为一个人可以拥有的稳定的社会关系数量大约是150。它最先由牛津大学的人类学家罗宾·邓巴（Robin Dunbar）提出，但也有很多人不认同。一些研究人员认为这个数字太小了；内向的人又认为这个数字大得离谱。但这个规模数字在很多情况下都会应验，例如由单人管理的教堂的会众人数，或是人们寄出的圣诞贺卡通常会抵达的全部家庭人数。企业也发现了它的重要性；越过150人的门槛需要改变管理实践，要从非正式和无书面凭证转向组织架构和系统流程化。

这些数字背后有个规律。它们以这样或那样的方式显现了做加法的风险。公司扩张到一定规模之后，人际联系就会减弱。邀请更多的人参加会议就要在开始时等待更久，要等所有人一一接入。增加额外的汇报关系，协作的负担会螺旋上升。

当然，“少即是多”的观点并不新鲜。19世纪的法国工程师马克斯·林格尔曼（Max Ringelmann）发现，在拔河队伍里增加更多人对单个人的出力产生了消极影响。拔河的人越多，每个人对结果的责任感就越弱，在拉绳子时也就越不出力。林格尔曼的见解仍然站得住脚。减法自有它的吸引力。■



Chips and the world

“Chip War” traces the evolution of the semiconductor industry

The world's chip industry is critical but worryingly fragile

Chip War. By Chris Miller. Scribner; 464 pages; \$30. Simon & Schuster; £20

SEMICONDUCTORS ARE the cornerstone of the modern economy. Everything from emails to guided missiles relies on them. Yet parts of the supply chain, particularly for cutting-edge chips, depend on choke-points dominated by a small number of firms. For decades few people worried much about this—until covid-19 and rising tensions between China and America highlighted the sector's fragility. In “Chip War”, his elegant new book, Chris Miller of Tufts University shows how economic, geopolitical and technological forces shaped this essential industry.

In 1947 a group of researchers at Bell Labs, a subsidiary of AT&T, a telecoms giant, invented the transistor, a switch that controls electric current and is a building block of modern electronics. Within a decade researchers were placing several transistors on a slab of silicon to make an “integrated circuit”, or chip. A thriving industry grew up around California, outsourcing low-value tasks, such as assembly, to Asia where labour was cheaper.

Innovation came quickly. In 1965 Gordon Moore, who later co-founded Intel, America's chipmaking giant, correctly predicted that by shrinking transistors, engineers would be able to double the number that fit on a chip every two years or so—and that this enhancement would, in turn, double a chip's performance.

As the market grew, so did interest from America's rivals. First, the Soviet Union tried and failed to replicate Silicon Valley. Later, Japanese firms such as Toshiba and Fujitsu managed to take a share of some chip markets. But

the strategic danger comes from China, which today spends more on importing chips than it does on oil. Xi Jinping, the president, has ordered China's tech titans to reduce its dependence on foreign chips; state funds dole out tens of billions a year to that end. Rather than matching America's know-how, however, a big priority is to emulate Taiwan, which produces 90% of the world's premium logic chips, which process data.

Taiwan's chip dominance can be traced to Morris Chang, founder of the Taiwanese Semiconductor Manufacturing Company (TSMC), who gave Mr Miller a rare interview. Mr Chang was born in China and grew up in Hong Kong. After an education in America he joined Texas Instruments, then a big chipmaker. He was obsessed with eking out efficiencies in the chip-manufacturing process. Passed over for the top job, in 1985 Mr Chang became involved in Taiwan's bid to gain a foothold in the semiconductor industry.

He duly put into practice a long-held idea for a firm that made chips designed by customers. At that point, virtually all large chipmakers designed and manufactured their silicon in-house. But as chips shrank, the cost of the factories that made them (or "fabs") grew: today building an advanced fab costs \$20bn. At the same time, the economics of the business favoured scale. The more chips a firm produces, the higher the yield—ie, the share of them that actually work. Thus, reasoned Mr Chang, only outfits that manufactured huge amounts of chips would be cost-competitive. With lavish support from Taiwan's government, TSMC was born.

At first, TSMC's technology lagged behind its American counterparts'. But, thanks to scale and Mr Chang's leadership, it soon caught up and overtook. Most American firms stopped making cutting-edge chips and relied on TSMC instead. Its success reshaped the industry, allowing fab-less design companies to flourish, without the financial burden of building pricey new factories every few years. Today TSMC is the biggest chipmaker in the world

by market value.

It is also one of the choke-points in the chip supply chain. The result of super-specialisation and high costs, these are huge vulnerabilities in the global economy. Only TSMC and Samsung, a South Korean tech giant, know how to make the world's most advanced chips. Most of their fabs are uncomfortably close to either China or North Korea. But the bottlenecks can also favour the West, because many are controlled by America or its allies. For instance, TSMC does not build chips for firms on America's blacklist, such as Huawei. Such obstacles have both slowed China's chip industry and redoubled its determination to become more self-sufficient.

America and Europe are pursuing greater self-sufficiency themselves. Thanks to the generous subsidies in America's recent CHIPS Act, Samsung and TSMC have agreed to build new fabs in Arizona and Texas respectively (albeit not the whizziest type). However, Mr Miller does not expect this to reduce American dependence on Taiwan and South Korea. Both Samsung and TSMC still concentrate their investment at home.

The author argues that R&D incentives may in the long run prove the most important part of the CHIPS Act: one lesson of history is that leaps in chip technology are often boosted by government research grants. That bodes well for the future of this critical and complex industry. For those seeking to understand it better, "Chip War" is a fine place to start. ■



芯片与世界

《芯片战争》追溯了半导体产业的发展历程

全球芯片产业至关重要，却非常脆弱，令人担忧【《芯片战争》书评】

《芯片战争》，克里斯·米勒著。Scribner出版社，464页，30美元；西蒙与舒斯特出版社，20英镑。

半导体是现代经济的基石。从电子邮件到制导导弹，一切都离不开半导体。然而半导体供应链的某些组成部分，尤其是涉及尖端芯片的那些，取决于由少数公司控制的关键节点。几十年来，很少有人对此感到担忧——直到新冠肺炎和中美之间日益紧张的关系令该行业的脆弱性显露无疑。塔夫茨大学（Tufts University）的克里斯·米勒（Chris Miller）在他文风简洁优雅的新著《芯片战争》（Chip War）中，向读者展示了经济、地缘政治以及技术等方面的力量是如何塑造这一重要产业的。

1947年，电信巨头AT&T的子公司贝尔实验室（Bell Labs）的一群研究人员发明了晶体管，这是一种控制电流的开关，也是现代电子设备的基本构件。不出十年，研究人员将几个晶体管放在一块硅片上，制成了“集成电路”，也就是芯片。一个欣欣向荣的产业在加州各地逐渐发展起来，组装等低价值工作则外包给了劳动力成本较低的亚洲。

创新很快就来了。1965年，后来和其他人一起创办了美国芯片制造巨头英特尔的戈登·摩尔（Gordon Moore）准确地预测到，通过缩小晶体管，工程师们大约每两年就能将芯片上的晶体管数量翻一番——而这种提升转而又会使芯片的性能提高一倍。

随着市场的发展，美国的竞争对手对芯片的兴趣也日益增长。先是苏联试图仿造出一个硅谷，但以失败告终。后来，东芝和富士通等日本公司在部分芯片市场上成功占据了一席之地。但战略性的威胁来自中国，中国目前在芯片进口上的支出超过了石油。国家主席习近平要求中国的科技巨头减少对外国芯片的依赖；为达此目标，国家资金每年拨款数百亿美元。然

而，中国大陆首要的任务不是匹敌美国的技术，而是赶上中国台湾——全球90%用于数据处理的高端逻辑芯片都产自中国台湾。

中国台湾在芯片领域的主导地位源于台积电创始人张忠谋，他难得地接受了《芯片战争》作者米勒的采访。张忠谋出生于中国大陆，成长于中国香港。在美国接受教育后，他加入了那时的一家大型芯片制造商德州仪器（Texas Instruments）。当时他痴迷于如何尽量提高芯片制造工艺的效率。没能晋升为德州仪器的掌舵人后，1985年，张忠谋开始投身于让中国台湾在半导体产业中获得立足点的努力。

他恰逢其时地将一个由来已久的想法付诸实践，即开办一家公司，生产由客户设计的芯片。当时，几乎所有大型芯片制造商都自行设计和制造芯片。但随着芯片尺寸缩小，芯片制造工厂（即“晶圆厂”）的成本在上升：如今建造一家先进的晶圆厂需耗资200亿美元。与此同时，芯片行业遵循规模经济。一家公司生产的芯片越多，良率（也就是实际能用的芯片比例）就越高。因此，张忠谋断定，只有大批量生产芯片的企业才具有成本竞争力。在中国台湾政府的大力支持下，台积电诞生了。

起初，台积电的技术落后于美国同行。但是，得益于规模化生产和张忠谋的领导，它很快赶超上来。大多数美国公司不再生产尖端芯片，转而依赖台积电。台积电的成功重塑了芯片产业，让不设晶圆厂的芯片设计公司得以蓬勃发展，而不必背负每隔几年就要花大价钱建造新工厂的经济负担。如今，按市值计算，台积电是全球最大的芯片制造商。

它也是芯片供应链中的关键节点之一。这些节点是极度专门化和高成本的结果，是全球经济中巨大的脆弱之处。只有台积电和韩国科技巨头三星掌握了世界上最先进的芯片制造技术。它们大部分的晶圆厂都靠近中国大陆或朝鲜，令人不安。但这些节点也可能对西方有利，因为其中许多是由美国或其盟友控制的。例如，台积电不为华为等美国黑名单上的公司生产芯片。这种障碍一方面减缓了中国大陆芯片产业的发展，一方面也大大增强了中国要变得更加自给自足的决心。

美国和欧洲自身也在追求更大程度的自给自足。由于美国前不久出台的《芯片法案》（CHIPS Act）提供了慷慨的补贴，三星和台积电已经同意分别在亚利桑那州和得克萨斯州建造新的晶圆厂（尽管不是最先进的那种）。然而，米勒并不认为此举会让美国减少对中国台湾和韩国的依赖。三星和台积电的投资都仍集中在本土。

他认为，从长远来看，激励研发可能是《芯片法案》中最重要的部分：从历史经验来看，芯片技术的飞跃往往是由政府研究经费推动的。对于这个关键又复杂的产业的未来，这是件好事。而对于那些想要更好地理解这个产业的人来说，《芯片战争》是个不错的起点。■



Schumpeter

Will Elon Musk-owned Twitter end up as a “deal from hell”?

Everything app. Or nothingburger

UNLIKE TOLSTOY’S description of families, mergers and acquisitions that end happily do so for a variety of reasons. It’s the unhappy ones that are alike. This is particularly true of M&A deals done at the top of the business cycle, when hubris runs amok, lofty valuations make acquirers sloppy with their money and the most radical ideas are made to sound plausible. In this category sits Elon Musk’s shotgun wedding to Twitter, once again in the offing after a judge gave both sides until October 28th to consummate it. Mr Musk’s latest attempt to justify it is to describe it as a step towards a Chinese-style “everything app”. It is just as likely to go down in history as a top-of-the-market “deal from hell”.

The annals of business have colourful examples of such Stygian mishaps. Sony’s ill-fated acquisition of Columbia Pictures in 1989 occurred when Japan’s bosses thought they were invincible, the bubble economy made any price appear worth paying, and dreams of the convergence of hardware (consumer gadgets) and software (entertainment) were in the air. AOL’s merger with Time Warner, an even bigger mess, was first announced in 2000 at the apogee of dotcom frothiness. The bosses of both companies, one an internet upstart, the other a fading media giant, fantasised about creating a colossus of the internet age. They torched nearly \$200bn of value in a matter of months. In 2007 Royal Bank of Scotland (RBS), an acquisitive financial institution, led a consortium to buy ABN AMRO, a sprawling Dutch banking group. It was the biggest banking takeover in history—yet done with little due diligence or oversight of gung-ho executives, even as the world was on the brink of the great recession. It occurred shortly before RBS’s spectacular demise and a bail-out from the British taxpayer.

Mr Musk's approach to Twitter is different from these in one important respect. He is acting in a personal capacity as the world's richest man. He has no known plans to integrate the social-media platform with Tesla and SpaceX, his electric-vehicle and rocket firms. Mercifully.

Yet the stock phrases that sum up such debacles—wrong target, wrong time, wrong price tag—already seem applicable to his pursuit of Twitter, and may explain why he has spent so long trying to wriggle out of the deal. If the two sides do not reach an agreement later this month, the judge says she will haul them back to the Delaware Court of Chancery and decide their fate for them. Whatever the outcome, Robert Bruner, a professor of business at the University of Virginia who in 2005 wrote a book called "Deals from Hell" to explain M&A fiascos, says Mr Musk's Twitter saga already bears many subtler hallmarks of the genre.

In Mr Bruner's diagnosis, the first hints of hell come from hubris. The self-styled "Technoking" has every reason for self-belief. Tesla is the world's most valuable carmaker. SpaceX is literally rocket science in action. Yet for executives like him it's a fine line from that to overconfidence. Sony's Morita Akio crossed it. So did AOL's Steve Case and RBS's Fred Goodwin. In Mr Musk's case, excessive faith in his ability to turn Twitter around is exacerbated by a saviour complex: his main goal, he said when he announced the deal in April, was furthering the cause of free speech. That appears to have blinded him to the need for due diligence. Moreover, like other exalted leaders, he is surrounded by yes-men. Billionaires compete to throw money at him. No chairman of any board appears to put a restraining hand on his shoulder. For now his reputation for walking on water continues to sustain him. But if he has overplayed his hand, history will not let him off lightly. Just ask Messrs Case and Goodwin (Morita passed away in 1999).

The corollary of hubris is sloppy financing, another attribute of top-of-the-

market megaflops. This is particularly true at the tail end of bull markets, such as the one that recently vanished in a puff of smoke. Not only was Mr Musk so unconcerned about overpayment that he based his \$54.20-a-share offer for Twitter on an overused cannabis joke. Big banks jostled to back one of the world's largest-ever buy-outs, even though by then cracks had started to appear in the market for leveraged loans.

As with many M&A deals, deteriorating markets can turn a flawed acquisition into a disaster. That possibility must haunt Mr Musk. The digital-advertising business on which Twitter depends has crumbled. Tesla's own shares, the source of most of his wealth, have lost a third of their value since he made the bid (don't cry for him, he is still worth \$220bn). The deal financing includes \$13bn of high-risk debt and spreads on this kind of instrument have soared. Whether Mr Musk reaches a deal with Twitter or the judge forces the sale to go ahead, the repercussions are likely to be troubling. Either banks are stuck with hard-to-sell debt and suffer hefty losses or, in the unlikely event they abandon the deal, a superhero of 21st-century capitalism faces a \$44bn day of reckoning.

| *The X-factor*

Finally there is strategy. In Mr Bruner's analysis, the worst M&A deals are done when the target is in an industry far beyond the acquirer's "domain knowledge". That is surely true of Mr Musk and Twitter. It may explain why he has started to offer hints of a grander strategic vision. He has raised the prospect of reducing Twitter's reliance on advertising, and instead incorporating it into an "everything app", known as X, with online payments that hark back to the days when he helped found PayPal. It is a tantalising idea. The model is WeChat, Tencent's superapp in China. Others, like Meta, have tried it with mixed results.

If it works, it would provide yet further testimony to Mr Musk's ineffable genius. But it also has a hellish side. It could pit the world's most powerful

businessman against tech regulators. It could stir up trouble geopolitically (imagine a reinstated Donald Trump weighing in, as Mr Musk has done, on Russia and Ukraine). And as a result it could anger China, thwarting Tesla's prospects there. Another deal for the history books, no doubt. ■



熊彼特

马斯克收购推特会是一场“地狱交易”吗？

全能应用，还是“空心汉堡”？

和托尔斯泰对家庭的描述不同，成功的并购各有各的原因，失败的并购才都是相似的。在商业周期的顶峰做出的并购交易尤其如此，那时狂妄情绪高涨，高估值令收购者兴奋地挥金如土，最激进的想法也被包装得合情合理。马斯克与推特这桩强扭的婚姻就是其中一例。随着法官裁定双方须于10月28日之前完成交易，这项收购再次启动。马斯克最新拿出的收购理由是这是向打造中国式“全能应用”迈出的一步。但它同样有可能成为人们记忆中一桩在市场顶峰达成的“地狱交易”。

像这样暗黑的灾难在商业史上有丰富的案例。1989年，索尼收购哥伦比亚电影公司，当时日本的老板们自认强大无敌，在泡沫经济中甘愿接受任何出价，梦想着“软（娱乐业）硬（消费电子产品）兼收”，但结局惨淡。美国在线与时代华纳的合并更是一团糟。该收购案最早公布是在网络泡沫巅峰时的2000年。一方是互联网新贵，另一方是渐渐失势的媒体巨头，两家公司的老板幻想打造一个互联网时代的巨无霸。他们在短短几个月内烧掉了近2000亿美元的市值。2007年，不断收购扩张的苏格兰皇家银行（RBS）牵头一个财团收购庞大的荷兰银行集团荷银（ABN AMRO）。这是银行业史上最大的收购案，但它发生在全球即将滑入经济大衰退之时，而收购过程中竟然没做多少尽职调查，对狂热促成交易的高管也几无监督。之后不久，苏格兰皇家银行便轰然坍塌，要靠英国纳税人的钱拯救。

相比上述案例，马斯克对推特的收购有一个重要区别。他是以世界首富的个人身份行事的。目前没有已公开的计划显示他要把这个社交媒体平台和他的电动汽车公司特斯拉及火箭公司SpaceX整合。谢天谢地。

然而，“错误的对象”、“错误的时机”、“错误的标价”等概括失败并购的常用词似乎都可以套用在马斯克对推特的收购上，或许也可以解释他为什么花这么长的时间试图抽身而出。假如双方在本月早些时候不能达成协议，

那位裁决法官表示会把他们拽回特拉华州衡平法院，替他们决定命运。无论结果如何，在2005年出版了《地狱交易》（Deals from Hell）一书分析并购惨案的弗吉尼亚大学商科教授罗伯特·布鲁纳（Robert Bruner）表示，马斯克与推特的收购闹剧已经显现出地狱交易的诸多更微妙的特征。

据布鲁纳的诊断，第一股“地狱”的气息来自狂妄。自诩“技术之王”的马斯克有充分的理由保持自信。特斯拉是全球市值最高的汽车制造商；SpaceX就是尖端科学的化身。然而，对他这样的高管而言，自信和过度自信只是一线之差。索尼的盛田昭夫越过了这条细线。美国在线的史蒂夫·凯斯（Steve Case）和苏格兰皇家银行的弗雷德·古德温（Fred Goodwin）也是。至于马斯克，他想一举扭转推特的命运本来就是过分自信了，他的救世主情结更是火上浇油：他在4月宣布收购计划时说自己的主要目标是推动言论自由。这似乎让他忽视了做尽职调查的必要性。此外，跟其他位高权重的领导人一样，他身边也围绕着一群惟命是从的应声虫。亿万富翁们竞相向他投钱。似乎没有哪个董事会主席会出手阻拦他。目前，他缔造奇迹的名声仍然能支持他的做派。但万一他玩过了火，历史是不会轻易放过他的。看看凯斯和古德温就知道了（盛田昭夫于1999年去世）。

狂妄的必然结果是草率融资，这是市场顶峰时并购惨案的另一特征。在牛市的尾声（比如在最近烟消云散的牛市）尤其如此。马斯克本人全不担心出价过高——他给推特开出每股54.20美元的报价甚至还是基于一个玩烂了的大麻梗。而且大银行争相支持这宗全球史上最大的收购案之一，尽管当时的杠杆贷款市场已开始出现裂缝。

跟许多并购交易一样，市场恶化会令原本就有缺陷的收购变成一场灾难。马斯克想必是考虑到这种可能性才举棋不定。推特所依赖的数字广告业务已经崩塌。自他出价收购推特以来，特斯拉自己的股票这一马斯克财富的大头已经跌去了三分之一（不用替他掉泪，他还有2200亿美元身家）。该交易融资包含130亿美元的高风险债务，而这种工具的利差已大幅上升。无论马斯克是与推特达成协议，还是法官强制完成收购，其后续影响都可能令人不安。要么是银行陷于难以转售的债务，蒙受巨额损失，要么是它们放弃这笔交易（可能性不高），马斯克这位21世纪资本主义超级英雄都

面临价值440亿美元的“末日清算”。

| X因素

最后是战略问题。据布鲁纳分析，在最糟糕的并购交易里，被收购方所在的行业远不在收购方的“领域知识”范围内。马斯克和推特无疑是这样。这也许能解释他为什么开始透露更宏伟的战略愿景。他提出要减轻推特对广告的依赖，转而把它纳入一个名为X的“全能应用”中，其中包含在线支付功能（让人想起他当年参与创立的PayPal）。这是个挺吸引人的点子，参考模板是腾讯在中国的超级应用微信。Meta等其他公司也尝试过，但结果好坏不一。

假如成功，这将进一步证明马斯克那不可言喻的天才。但它仍有暗黑的一面。它可能会让世界上最有权势的商人和科技监管机构硬碰硬。它可能挑起地缘政治事端（想象一下，特朗普账号被恢复，然后像马斯克那样在俄乌问题上指点江山）。结果可能激怒中国，阻碍特斯拉在中国的发展。毫无疑问，这又是会载入史册的一笔。■



The end of 2%

Policymakers are likely to jettison their 2% inflation targets

Some by choice, some by accident

THE LAST time rich economies conquered inflation it ushered in a decades-long era known as the “great moderation”. From the mid-1980s to 2007 growth was steady, inflation was low and economists celebrated their own “end of history”: the triumph of inflation-targeting technocracy over the naivety of 1970s policymaking. The economy was steered by a simple division of labour. Central banks would use monetary policy to keep inflation on target—typically at 2%—while governments would keep debts under control and focus on supply-side reforms.

This stability was shattered by the financial crisis. The 15 years since have exposed flaws in the macroeconomic regime. When interest rates fell to zero, central banks could not easily cut them further, making recovery from the crash slow and painful. When the pandemic struck, policymakers feared a repeat and so reached for alternatives: an enormous expansion of government spending and quantitative easing (QE), the buying of public debt with newly created money, whose full effects were poorly understood. The experiment went wrong, particularly in America. Inflation returned with a vengeance, and has since been worsened by an energy crisis—the response to which in Europe has been another round of government spending on a vast scale.

Today, as the balance of economic power tilts from technocrats towards politicians, it is unclear whether inflation can be brought back to the 2% target. Central bankers are keen to follow the path of the 1980s, imposing growth slowdowns—and, if necessary, recessions—to reach their goal. But the enormous support for households and businesses during the pandemic and the energy crisis has fed expectations that downturns will be met by

government handouts, not welcomed as a cure for inflation. Although voters may be angry about the rising cost of living, they will lament higher unemployment once it hits. And if the energy crisis abates inflation will fall from today's sky-high rates to a level that will still be above 2%, but may seem more politically tolerable, in part because rising prices will be matched by rising wages.

The good news is that out of crisis springs opportunity: to fix a fundamental problem with the system. Interest rates have fallen close to their zero lower bound in part because societies have aged, creating a global glut of saving and a dearth of investment opportunities. These conditions determine the real (ie, inflation-adjusted) rate of interest in the long term, and are not going away. Yet for any given real rate, higher inflation raises the nominal rate that can be set by central banks. As a result, long before the pandemic, many economists were arguing in favour of a modest increase in the inflation target, to 3% or 4%, to get rates away from zero and build up monetary-policy firepower.

Before 2021 the idea seemed distant and academic. Inflation was too low; it would be naive to aim higher. Today, a change of target would be simple to make. Policymakers should reduce inflation to 4%, say, and then stop. Though monetary policy would be more doveish in the short term, rates would eventually settle higher than they would have been under a 2% target. Central banks would get their mojo back.

Is such a switch viable? In the short term there would be costs and benefits. There would be no need for a deep and unpopular disinflationary purge, reducing the danger of conflict between central banks and politicians. Governments would not need to worry that spending on security or on long-term climate investment might interfere with central banks' desire to squeeze economies. There would even be a budgetary windfall. Moving from a target of 2% to 4% would inflate away some long-term public debt

that, on average across five big economies, would be roughly equivalent to the rise in public debt during the pandemic.

The big downside would be a knock to the credibility of policymakers' promises. Having been burned once, buyers of long-term government bonds might fear the inflation target could be raised again, adding a risk-premium to bond yields and creating long-term uncertainty. Inflation of 3-4% would be that little bit more noticeable than 2%, imposing a psychological burden on the public and creating some friction throughout the economy. There would be arbitrary redistribution from creditors to debtors.

Yet this trade-off is minor set against the benefits of escaping the zero lower bound and returning to a system in which interest rates play the main role in fighting recessions. Milder downturns are an enormous economic prize. If monetary policy had had more firepower over the past 15 years, the slump of the 2010s would have been shallower. The mistakes that led to the post-pandemic overheat would have been less likely. Governments would have been less indebted. There could have been less QE.

One problem would remain. Just as in the old system, the power of central banks to control inflation would require governments to keep debts stable as a share of the economy in the long term—a commitment that is now under threat. The crises of recent years will be followed by more spending on pensions and health care as societies age, as well as a mass decarbonisation project that will cost more the longer it is delayed. Politicians of all stripes fear the prospect of cutting spending on elderly voters more than they fear deficits.

It would therefore be wise to pair any change to the inflation target with long-term reforms to control pension and health-care spending, to put

public finances on a more stable footing. The one-time fiscal windfall from the new regime would provide some breathing space. But adjusting the inflation target must not become the go-to escape valve whenever budgets are tight.

There are broader options for deeper reform. A higher inflation target could be embedded into an overall goal for the level of nominal GDP, the total amount of cash growth in the economy, a gauge that is better suited for a world of supply-side shocks like the energy crisis. What has become clear is that inflation held to 2% is ill-suited to 21st-century macroeconomic conditions. And if the target is not changed, there is a great risk that it will simply be missed. Better to construct a new macroeconomic regime carefully than just to wait for the old one to collapse. ■



2%的终结

政策制定者很可能放弃2%的通胀目标

几分自愿，几分偶然

上一次发达经济体驯服通胀时，开启了长达数十年的“大稳健”时代。从1980年代中期到2007年，经济稳步增长，通胀保持低位，经济学家欢呼着属于他们的“历史的终结”：以通胀为目标的技术治理胜过了1970年代不成熟的政策制定。经济由一种简单的分工指导。央行负责运用货币政策将通胀控制在目标范围内——通常是2%，而政府负责控制债务水平并聚焦供给侧改革。

金融危机击碎了这种稳定。此后的15年里，这种宏观经济制度的弊端暴露了出来。当利率已降到零，央行难以进一步降息，这使得经济从崩溃中复苏的过程缓慢又痛苦。当疫情来袭时，政策制定者担心重蹈覆辙，祭出了替代方案：大幅扩张政府支出和量化宽松（QE，用新发行的货币购买公共债务），但对其全面影响缺乏了解。实验失败了，尤其是在美国。通胀卷土重来，并因能源危机而进一步加剧——欧洲对此的反应是新一轮大规模政府支出。

如今，随着经济力量的天平从技术官僚向政客倾斜，无从知晓通胀能否回到2%的目标。央行官员仍然热衷于效仿1980年代的做法，迫使经济增长放缓——必要时不惜引发衰退——以达到他们的目标。但在疫情和能源危机期间政府为家庭和企业提供了大力援助，这让人们觉得在经济低迷期政府也会出手救助，而这对控制通胀并无好处。尽管选民可能对生活成本上升感到愤怒，但一旦失业率攀升，他们更会怨声载道。如果能源危机缓解，当前超高的通胀将会回落，虽然仍会高于2%，但在政治上似乎更容易接受，原因之一是物价上涨的同时工资也会涨。

好消息是在危机中萌生了机遇，有望解决经济体系的一个根本问题。利率已降至接近零下限，部分原因是社会老龄化，导致全球储蓄过剩而投资机会匮乏。这些条件决定了长期实际利率（即经通胀调整的利率）的水平，

并将持续存在。然而，无论实际利率为何，较高的通胀都会推高央行可以设定的名义利率。因此，早在全球疫情前很久，许多经济学家就已经主张将通胀目标适度提高至3%或4%，从而摆脱零利率，同时给施展货币政策创造空间。

在2021年之前，这种想法似乎还遥不可及、流于空谈。当时的通胀如此之低，把目标升高是稚拙之举。如今，要调整目标是轻而易举的事。政策制定者应该把通胀降低到一定程度，比如4%，然后收手。虽然短期内货币政策会偏温和，但最终的利率水平仍会比在2%的通胀目标下要高。央行将重新获得腾挪的空间。

这样的转变是否可行？短期内既有代价也有好处。不必进行不受欢迎的深度反通胀管制，也就降低了央行与政客之间发生冲突的风险。政府不必担心在安全或长期气候投资上的支出可能会妨碍央行紧缩经济的意图。甚至它还会带来一笔预算上的横财。把通胀目标从2%提高到4%，将可以通过通胀抵消掉一部分长期公共债务，从五个大经济体的平均水平来看，抵消的部分与疫情期间公共债务的增幅大致相当。

最大的不利因素是政策制定者的信誉将受到打击。吃过苦头的长期国债的买家可能担心通胀目标还会上调，从而增加债券收益率的风险溢价，造成长期不确定性。3%到4%的通胀比2%更扎眼一些，会给公众造成心理负担，并在整个经济中形成一些摩擦。将出现从债权人到债务人的任意的财富再分配。

但是，与摆脱零利率下限、重新让利率在对抗衰退中发挥主要作用的好处相比，这样的代价并不算大。能减轻经济低迷的程度是巨大的经济胜利。如果过去15年里货币政策能有更多发力的空间，那2010年代的衰退就不会那么严重。导致后疫情期经济过热的错误更可能被避免。政府的负债会少一些。量化宽松可能也会少一些。

有一个问题依然会存在。正如在旧体系的年代，央行若要有效控制通胀，政府就必须长期保持债务在经济中占比的稳定——而这一承诺现在岌岌可

危。在近年的危机之后还会有更多支出，包括伴随社会老龄化而来的更多养老金和医疗支出，以及对大规模脱碳项目的投资——这类项目延迟越久，成本将越高。各党各派的政客都担心削减对老年选民的支出可能造成的后果，甚于对赤字的担忧。

因此，明智的做法是在调整通胀目标的同时配以控制养老金和医疗支出的长期改革，让公共财政的基础更加稳健。新制度带来的一次性财政横财可以提供一些喘息的空间。但是，绝不能一出现预算吃紧就用调整通胀目标来应急。

还有更广泛的选择来推行更深入的改革。可以将更高的通胀目标纳入到名义GDP水平的总体目标之中。名义GDP是经济中现金增长的总量，这一尺度更适用于受到供给侧冲击（如能源危机）的环境。已经清楚的一点是，2%的通胀目标已经不适合21世纪的宏观经济状况了。而如果不更改这个目标，最后它很可能也是实现不了的。与其坐等旧体系崩溃，还不如谨慎地建立一个新的宏观经济制度。 ■



Free exchange

Why China's policymakers are relaxed about a falling yuan

They have learnt how to walk down stairs

IN 1988 PAUL KRUGMAN, a Nobel-prizewinning economist, wrote that it was “fairly likely” the world would soon shift away from freely floating exchange rates. Governments would instead adopt a system of “broad target zones”, promising to stop their currencies wandering too far above or below a fixed exchange rate.

He was wrong—but a version of this future can be seen in China. Each morning its central bank sets an exchange rate for the yuan known as the “fix”. China’s currency can float 2% above or below this rate each day. The zone is narrower than Mr Krugman expected and its mid-point moves each morning in discrete steps. Yet it is similar enough that economists at Hamburg University have called it a staircase-shaped “moving Krugman band system”.

The stairs have been steep of late. Since mid-April, the yuan has declined by about 10% against the dollar; a decline slowed (but not stopped) by the morning fix. On its way down, the currency has passed psychologically important thresholds. In August it crossed 6.8 to the dollar, close to the level at which the yuan was pegged after the global financial crisis of 2008-09. On September 26th the central bank set the fix at more than seven yuan to the dollar for the first time since the early stages of the covid-19 pandemic.

The reason for this descent is clear. America’s Federal Reserve has raised interest rates aggressively to curb inflation. To stabilise the yuan, China’s central bank could raise interest rates in tandem. But tighter monetary policy would be at odds with the needs of its weak economy, which is

hampered by a property slump and draconian covid controls.

What is less clear is where the bottom of the staircase lies, and how sure-footed the descent will be. Some analysts fear a repeat of 2015, when a poorly executed devaluation of the yuan provoked capital outflows that further undermined the currency. But a rerun is unlikely. The yuan is no longer overvalued. Its target zone is better managed and its capital controls are better enforced. In the past China kept its currency anchored to the dollar, because it feared that a conspicuous drop would trigger a run on its currency. The yuan's decline against the dollar is now less likely to become disorderly. For that reason, China will try less hard to prevent it.

In assessing China's currency choices, economists sometimes invoke the "impossible trinity". A country might want exchange-rate stability, monetary independence and free capital flows, but it can have only two of these. Rich countries typically make clear-cut choices. As Joshua Aizenman of the University of Southern California has pointed out, emerging economies are more ambivalent. Many have adopted mixed positions, embracing none of the objectives in full, nor rejecting any entirely. By imposing limited controls on capital, say, they can provide some stability to their exchange rate, without entirely forgoing monetary independence.

China has clung to exchange-rate stability more than most. The yuan has been less volatile than India's rupee, let alone South Africa's rand or Brazil's real. But China has also adopted tighter capital controls, especially since 2015. This can be inefficient and inconvenient. It is, however, not outlawed by the impossible trinity.

China can also take comfort from the economic fundamentals. Despite its insulation from market forces, its exchange rate is reasonably well priced. Adjusted for inflation, it is about 10% below its fair value, according to the Institute of International Finance. It has remained stable this year against a

broader basket of currencies. If only the fundamentals applied, it ought not to plummet.

Unfortunately, financial markets are not respectful of such calculations. “Few will heed fundamentals...in times of turbulence and turmoil,” as Zhou Xiaochuan, then China’s central-bank governor, put it in 2016. Expectations of yuan declines can become self-fulfilling, regardless of the underlying state of the economy.

Mr Krugman showed that target zones, if credible, could ameliorate this problem, by converting speculators into stabilisers. As the exchange rate reaches the bottom of the zone, its room for further declines is limited. Knowing that, speculators would push it back to the middle. The mere prospect of intervention by the authorities could make actual intervention unnecessary.

That did not work in China in 2015 partly because of the way its stairs were built. Each morning’s fix was supposed to reflect the currency’s value at the end of the previous trading session. Thus any speculative declines during trading could be embedded in the following morning’s fix. Within any single day, the zone might constrain the speculators. But from one day to the next, the speculators could move the zone.

| *In need of a fix*

To restore stability and credibility, China sold more than \$700bn of foreign-exchange reserves in 2015-16 and enforced its capital controls more zealously. It introduced a mysterious “counter-cyclical factor” in its calculation of the morning fix, intended to offset any speculative momentum. It also imposed a reserve requirement on banks that made it costlier to bet against the yuan. That requirement was removed in 2020, only to be restored last month.

Having taken these measures, China now seems more confident that the yuan can fall against the dollar without the fall becoming self-reinforcing. For this reason, the yuan now seems less anchored to America's currency. Economists have looked at how faithfully the yuan mimics movements in the dollar against other currencies. In the dark days of 2015, it moved one to one. In recent years, the dollar's influence has steadily declined, according to Chen Zhang of the National University of Singapore and colleagues, falling from one to about 0.3.

China might cling more tightly to the dollar in a period of great financial stress. But it is otherwise unlikely to intervene heavily to defend any particular value of the yuan to the dollar. The country's policymakers do not mind if the yuan walks steadily down the stairs. Just as long as it does not tumble. ■



自由交流

为什么中国的政策制定者对人民币贬值泰然自若

他们已经学会了如何下楼梯

诺贝尔经济学奖得主保罗·克鲁格曼（Paul Krugman）在1988年写道，世界“很可能”很快就会放弃自由浮动汇率。各国政府会转而采用一种“宽泛的汇率目标区”体系，承诺让本国货币在一个固定汇率水平的附近上下浮动而不会偏离太多。

他想错了——不过他预想的未来以某种形式在中国上演。每天上午，中国人民银行都会为人民币设定一个叫作“中间价”的汇率。人民币每天可以在这一汇率上下2%的幅度内浮动。这一区间比克鲁格曼预计的要窄，并且它的中间价在每天上午的变动是不连续的。但它已经与之足够相似，德国汉堡大学（Hamburg University）的经济学家称它为楼梯式“移动克鲁格曼区间体系”。

最近这些楼梯很陡峭。自4月中旬以来，人民币兑美元汇率大约下跌了10%；上午发布的中间价减缓了（但没有止住）这一下跌。在下跌过程中，人民币汇率越过了几个重要的心理关口。8月，人民币兑美元汇率突破6.8元，接近2008至2009年全球金融危机之后人民币盯住美元的水平。9月26日，人行自新冠疫情初期以来首次将人民币兑美元的中间价定在七元以上。

人民币下跌的原因很明显。美联储大幅加息以抑制通货膨胀。要稳定人民币，人行本可以同步加息。但鉴于中国经济受到房地产滑坡以及严苛的新冠疫情防控措施的拖累，收紧货币政策将不符合提振本国疲软经济的需求。

目前不那么清楚的是这楼梯的尽头在哪里，以及下楼梯的脚步会有多稳当。一些分析师担心会重蹈2015年的覆辙——当时由于人民币贬值执行不当，引发了资本外流，进一步损害了人民币汇率。但这一幕不太可能重

演。人民币不再被高估。它的汇率目标区得到了更好的管理，资本管制也执行得更好。过去，中国一直让人民币牢牢锚定美元，那是因为担心人民币明显贬值会引发挤兑。而现在，人民币对美元的贬值不太可能滑向失控局面。因此中国也不会花那么大的力气来防止贬值。

在评估中国的货币政策选择时，经济学家有时会提及“不可能三角”。一个国家可能同时想要汇率稳定、货币政策独立自主和资本自由流动，但它只能拥有其中两项。富裕国家通常会做出明确的选择。而南加州大学（University of Southern California）的乔舒亚·艾泽曼（Joshua Aizenman）指出，新兴经济体的做法更加模棱两可。许多国家采取了混合立场——不追求哪一项做到百分之百，也不完全拒绝任何一项。比如说，通过施加有限的资本管制，它们可以为本国汇率提供一定的稳定性，但也没有完全放弃货币政策自主。

中国比大多数国家都更执着维持汇率稳定。人民币的波动小于印度卢比，更不用说南非兰特和巴西雷亚尔了。但中国采取的资本管制也更为严格，尤其是在2015年后。这样做可能低效又麻烦，但并没有完全违背“不可能三角”。

中国也可以因经济基本面而稍微放宽心。尽管人民币汇率不受市场力量的影响，但其定价还是相当合理的。根据国际金融协会（Institute of International Finance）的数据，经通胀调整后的人民币汇率比其公允价值低10%左右。人民币兑一篮子货币的汇率今年仍然保持稳定。如果只从基本面出发，它应该不会暴跌。

可惜金融市场对这类考量并不买账。“在大动荡、大乱局之中是不会有有多少人注重经济基本面的。”2016年，时任人行行长的周小川如此说道。无论经济的基本状况如何，人民币贬值的预期可能会自我实现。

克鲁格曼的理论表明，如果汇率目标区可靠，它可以通过将投机者变成“稳定器”来缓解这一问题。当汇率接近目标区底部时，它进一步下跌的空间有限。知道了这一点，投机者就会把它推回到中间价。只要有当局会干

的预期，实际干预就变得不必要了。

2015年，这个理论在中国没有奏效，部分原因是楼梯的建造方式。按设定，每天上午的汇率中间价反映的是人民币在上一个交易日的收盘价。这样一来，交易期间任何投机行为引发的下跌都会被嵌入到第二天上午的中间价中。在任何一个单独的交易日内，该浮动区或许都能限制投机者。但从一个交易日到下一个交易日，投机者可能会改变浮动区的范围。

| 修正中间价

为了恢复稳定和信誉，中国在2015至2016年出售了逾7000亿美元的外汇储备，并且更加积极地实施资本管制。它在计算早盘中间价时引入了神秘的“逆周期因子”，以抵消任何投机性动量。中国还对银行提出外汇风险准备金率要求，加大了做空人民币的成本。这项要求在2020年取消，但上个月又恢复。

在采取了这些措施之后，中国现在似乎更有信心做到人民币兑美元的下跌不会形成自我强化。也因此，人民币现在似乎弱化了对美元的锚定。经济学家研究了人民币在多大程度上跟随美元兑其他货币的变动。在2015年的黑暗时期，人民币是按一比一跟随。根据新加坡国立大学的张晨（音译）及其同事的研究，近年来，美元的影响力稳步下降，跟随比率从1降到了约0.3。

在金融压力巨大的时期，中国可能会更紧盯美元。但除此之外，它不太可能大力干预以求让人民币兑美元汇率保持在任何特定水平。只要人民币稳当地下楼梯，中国的政策制定者并不在意。别栽跟头就行。■



Hot property

Why Wall Street is snapping up family homes

The opportunity is unprecedented, but comes with risks

HOUSING IS THE world's biggest asset class. But until recently renting out family homes was a mom-and-pop cottage business, seen as uninvestable by Wall Street. When Blackstone, a private-equity giant, floated the idea of creating vast portfolios of homes after the global financial crisis of 2007-09, banks refused to lend to it. The firm ran the idea by Sam Zell, a property mogul who sold Blackstone his \$39bn office empire before the financial crisis. "No way," he retorted. For an investor routinely splurging on hotel chains and swanky office towers, the buy-to-let business seemed like small fry by comparison.

Blackstone went ahead despite Mr Zell's advice. A decade on from the first purchase in Phoenix, Arizona—an outlay worth \$100,000—the experiment has morphed into an institutional-grade asset class. Last year interest in the sector reached fever pitch. According to John Burns Real Estate Consulting, a research firm, big investors committed at least \$45bn to buying single-family homes in America, up from \$3bn the year before. Even as housing markets cool, investment is pouring in, with firms including Goldman Sachs and KKR following in Blackstone's footsteps.

It is easy to see why. Between 2016 and 2021, annual returns from family rentals (of 21%) have outperformed those of housing for old folk (7%), offices (5%), shopping malls (-1%) and even apartments (12%), according to Green Street, another research firm. In the past decade, the value of homes owned by institutions has doubled to \$4.7trn, a figure that towers over the estimated value of America's offices, at \$1.9trn.

Unlike mom-and-pop investors, who tend to own no more than a handful

of homes, the biggest institutions hold tens of thousands, which are offered renovated and have around-the-clock maintenance. Invitation Homes, America's largest family landlord, says it spends an average of \$39,000 fixing up each one, kitting them out with new flooring, upgraded plumbing and the latest tech, such as video doorbells and smart locks.

These goodies are attracting richer tenants. Between 2010 and 2018, those with incomes of above \$75,000 accounted for three-quarters of the growth in renters. Covid-19 accelerated this, as bidding wars forced high-earners to rent. Invitation Homes says its residents now have an annual household income of above \$131,000, nearly twice the country's median.

There is plenty of room for further expansion. In America, real-estate investment trusts (REITs) own just 1% of single-family rentals, compared with 5-10% of offices and warehouses, 15% of housing for old people and 50% of shopping malls. Big investors are also starting to build more, rather than just buying up existing stock. Last year, they built a record 7,705 family units, up from an average of 5,500 in 2015-20. By 2030, MetLife Investment Management, an asset manager, expects institutions to have amassed 7.6m homes, more than two-fifths of all family rentals.

The trend has also spread to Europe. Investors such as Aviva and Legal & General are building thousands of rental homes across Britain, which now has more than 73,000 "build to rent" properties. Institutional investors are also gobbling up property in Germany, Ireland, the Netherlands and the Nordic markets, which have higher shares of renters than other rich countries.

What's behind the explosive growth? One explanation is that ageing millennials offer a growing market. As they approach their late 30s and early 40s—a sweet spot for landlords—many want better schools for their children or space for pets, or finally have enough money to dump their

housemates. In America, population growth in this age category will nearly double over the next five years. Ageing baby-boomers are also renting in higher numbers. In England, the proportion of those aged 55 to 64 who are renting has almost doubled since 2011.

Declining housing affordability helps. Those unable to buy homes have little choice but to rent, meaning landlords are confident of their ability to find and keep new tenants, especially for entry-level homes. In America, at least 420,000 starter homes were built each year in the 1970s. Last year, just 93,000 were. Thus rents continue to climb. Across the country, those for family homes rose by more than 13% in June compared with a year earlier. In Orlando, they were up by 23%. In Miami, by more than a third.

Despite rising rents, Wall Street landlords are not immune to economic uncertainty. Inflation means the cost of renovating and maintaining homes is rising. Invitation Homes says the amount it spent on these things rose by nearly 8% in the second quarter of this year. Construction costs have also risen, posing risk for investors building from scratch. Prices for building materials, including concrete, lumber and steel, have surged by 38% since the start of 2020. Interest-rate rises are another worry; as the market softens, investors are taking a more cautious approach. Home Partners of America, owned by Blackstone, announced in August that it would pause home purchases in 38 cities, markets that represent 5% of its activity.

Economic cycles are inevitable. Rents are unlikely to continue to climb at a record pace. Yet history suggests that residential rents are more resilient than those from other property types, especially in periods when supply is tight. From 1974 to 1985, another period of high inflation, rents actually increased by 7-12% a year, notes Jay Parsons, an economist at RealPage, a data firm. Even as homebuyer demand crashed during the global financial crisis, demand from residential tenants did not waver. Although the housing splurge of institutional investors may calm a bit, it is unlikely to

cease. ■



热门物业

为什么华尔街正在抢购独栋住宅

机遇前所未有，但也伴随着风险

住房是世界上最大的资产类别。但直到近些年，出租独栋房还是一个家庭经营的小生意，在华尔街看来不值得投资。当私募股权巨头黑石集团（Blackstone）在2007年至2009年全球金融危机后提出创建大量住房投资组合的想法时，银行拒绝向其放贷。黑石曾经把这个想法讲给房地产大亨山姆·泽尔（Sam Zell），金融危机前泽尔把自己价值390亿美元的写字楼帝国卖给了黑石。“行不通的。”他断然否定。对于一个经常在连锁酒店和豪华写字楼上砸大钱的投资者来说，买房子出租的生意比起来似乎还不够塞牙缝的。

但黑石最后也没听泽尔的。它花10万美元在亚利桑那州凤凰城买下第一栋房子，十年过去了，这个实验已经演变为机构级的资产类别。去年，人们对这个版块的兴趣堪称狂热。据研究公司约翰·伯恩斯房地产咨询（John Burns Real Estate Consulting）称，大投资者已投入至少450亿美元在美国购买独栋房，而前一年还只是30亿美元。在房地产市场降温之时，投资仍在涌入，包括高盛和KKR在内的公司也在追随黑石的脚步。

原因显而易见。另一家研究公司Green Street的数据显示，2016年至2021年间，独栋住宅出租的年回报率（21%）超过了老年公寓（7%）、写字楼（5%）、购物中心（-1%），甚至公寓（12%）。在过去10年里，机构拥有的独栋住宅价值翻了一番，达到4.7万亿美元，大大高于美国写字楼1.9万亿美元的估计价值。

与那些往往只拥有几栋房子的作坊式小投资者不同，最大型的机构拥有数万栋住宅，它们将房屋翻新后出租，并提供24小时维护。美国最大的独栋住宅租赁商Invitation Homes表示，平均每栋房子要花3.9万美元来修理，为它们安装新地板、升级管道，并配备最新科技，如可视门铃和智能锁。

这些好东西正吸引着更富有的租户。2010年至2018年间，收入在7.5万美元以上的人占了新增租户的四分之三。新冠疫情加速了这一趋势，因为买房竞价大战迫使高收入者租房。Invitation Homes表示，其租户目前的家庭年收入超过13.1万美元，几乎是美国中位数的两倍。

进一步扩张的空间还很大。在美国，房地产投资信托基金（REITs）只拥有1%的单户出租房，相比之下，它拥有5%到10%的写字楼和仓库，15%的老年公寓和50%的购物中心。大型投资者不仅购买现房，还开始建造更多新房。去年，它们建造了创纪录的7705套独栋住宅，而2015年至2020年平均每年建5500栋。资产管理公司大都会人寿投资管理（MetLife Investment Management）预计，到2030年，机构将拥有760万栋住宅，占有独栋出租房的逾五分之二。

这一趋势也蔓延到了欧洲。英杰华（Aviva）和英国法通保险（Legal & General）等投资者正在英国各地建造数千栋独栋出租房，目前英国有超过7.3万栋“建成即出租”的房产。机构投资者也在德国、爱尔兰、荷兰和北欧抢购房产，这些国家的租房者比例高于其他富裕国家。

爆炸式增长背后的原因是什么？一种解释是，年纪渐长的千禧一代带来了一个不断增长的市场。当他们到了三十好几、四十出头时（房东心中的最佳租户年龄），很多人想让孩子上更好的学校，或是想给宠物多点空间，或者终于有足够的钱摆脱合租了。在美国，这个年龄段的人口在未来五年内将增长近一倍。步入暮年的婴儿潮一代的租房人数也在增长。在英格兰，55岁至64岁的租房人口比例自2011年以来几乎翻了一番。

购房能力下降也起了作用。买不起房子的人除了租房几乎别无选择，这让房东很有把握能找到并留住新房客，尤其是在简配房这个类别上。上世纪70年代，美国每年至少建造42万栋简配房，而去年只有9.3万栋。结果是租金继续攀升。全美6月独栋住房租金同比上涨超过13%。奥兰多上涨23%。迈阿密上涨超过三分之一。

虽然租金不断上涨，但华尔街的房东们也无法免受经济不确定性的影响。

通货膨胀意味着翻新和维护房屋的成本在上升。Invitation Homes称，今年第二季度，它的这部分支出增长了近8%。建筑成本也在上升，给完全新建房屋的投资者带来了风险。自2020年初以来，包括混凝土、木材和钢铁在内的建筑材料价格飙升了38%。利率上升是另一个担忧；随着市场走软，投资者采取了更加谨慎的做法。黑石旗下的Home Partners of America在8月宣布将暂停在38个城市购房，这些城市的住房购置占其投资活动的5%。

经济周期不可避免。租金不太可能继续以创纪录的速度攀升。然而历史表明，住宅租赁比其他类型的房地产更具韧性，尤其是在供应紧张的时期。数据公司RealPage的经济学家杰伊·帕森斯（Jay Parsons）指出，在1974年到1985年的另一个高通胀时期，租金实际上以每年7%到12%的速度增长。即使在全球金融危机期间购房需求大幅下降之时，租房需求也并未动摇。机构投资者的住房投资热潮可能会稍稍降温，但不太可能停止。■



Mind over matter

What does a brain-computer interface feel like?

Talking to Philip O'Keefe about the implant in his head

PHILIP O'KEEFE, a 62-year-old logistics worker and passionate fan of the Brisbane Lions, a local football team, also suffers from ALS, which has paralysed him. In 2020 a “stentrode” was inserted into a blood vessel in his brain from where it monitors activity in part of his cortex. The following year he used signals passed through that probe to send his first tweet: “hello, world! Short tweet. Monumental progress.” The Economist talked to him about the experience.

The Economist: What was your first reaction to the idea?

Mr O'Keefe: I wasn't too sure about the idea initially. I sought the advice of some friends in the medical field and they came back and said 'Yes, definitely be involved'. My initial thought was I would be able to think words or sentences that would be transcribed onto the computer. Once I understood what was involved I was very keen to be part of this.

The Economist: Did you have to spend some time making it work? Or did it work fairly instantly?

Mr O'Keefe: The first day there was a signal it was like waking up Christmas morning to find all the presents under the tree are yours. It was unbelievable.

The Economist: What has been the most surprising thing about the experience?

Mr O'Keefe: It's been remarkably unobtrusive. Because of my condition, we have a house with smart switches. So, if I am in front of the control screen, I

can turn the lights on or off anywhere in the house if I want to. I have done that to the kids a couple of times. It gets their attention.

The Economist: How is this helping you in your day-to-day life, work and relationship with the others?

Mr O'Keefe: Well, to be fair, my device is a first-generation device put in as part of the initial clinical trial. I was the second person in the world to receive it. The device is still obviously going through development stages. It enables me to use emails, to use apps like WhatsApp to scroll through various sites and do online banking. The ability to live a normal computer life is there. So, whatever you can do on a computer I can do. At this stage, I am a bit slower than you would be, but there is the ability to do almost anything if I want to.

When the device was implanted, I was still working part-time. I could do some of my online work with the device. I could go onto my company's portal and update information and produce reports.

The Economist: What would you say is the best thing about the implant?

Mr O'Keefe: From a physical perspective, the best thing is you don't know it's there. There is no irritation. For me the device has become a part of my life. It's quite a seamless process. In fact, it gives you back the ability to be independent. There is no doubt from my perspective being involved in this gave me a reason to live. It gave me back a lot more enjoyment about life and gave me things to do, it gave me the ability to stay in touch with what's going on.

The Economist: What would you like to tell the readers about brain-computer interfaces?

Mr O'Keefe: This is a new horizon. It really is. The human brain is an

amazingly complex thing. Having a direct link between your brain and your computer, it's just another step down the path of human evolution. I mean, 120 years ago we couldn't fly and now we are talking about sending people to Mars. It's another step in technology. Yes, we need to be careful about what we do but we are human beings, we need to understand, we need to learn.

The Economist: Do you feel enhanced in any way?

Mr O'Keefe: Do I feel enhanced? Do I feel like Superman? No, I don't. I do feel very fortunate through misfortune to be able to do this. I get a sense of pride when I talk to people and see their eyes open up in amazement. I'm very happy that what I've done has been successful. I'm grateful for the attention they give to me. But I don't see myself as some super being. I'm just a bloke who got involved in a process and who was able, with some very smart people, to prove a concept and prove it worked. And it will get bigger and better. ■



头脑战胜疾病

脑机接口是什么感觉？

和菲利普·奥基夫聊一聊他头颅中的植入设备【专题《修复大脑》系列之三】

菲利普·奥基夫（Philip O’Keefe）是一名62岁的物流业员工，也是一支地方澳式足球队布里斯班雄狮（Brisbane Lions）的热情粉丝。他患有肌萎缩侧索硬化症，并因此而瘫痪。2020年，一个“stentrode”被插入到他大脑的血管中，从那里监测他部分皮层的活动。第二年，他使用通过该探测器传递的信号发送了他的第一条推文：“你好，世界！短推文。巨大的进步。”《经济学人》就这次经历采访了他。

《经济学人》：您对这个实验的第一反应是什么？

奥基夫：我最初对这个主意有点拿不准。我征求了一些医学界朋友的意见，他们告诉我“是的，一定要参与”。我最初的想法是，我将能够思考单词或句子并被转录到计算机上。一旦我了解了项目涉及的内容，我就非常渴望参与了。

《经济学人》：您是否花了一些时间才让它开始正常运作？还是它上来就能用？

奥基夫：第一天就有了一个信号，就像圣诞节早上醒来发现树下所有的礼物都是你的一样。这太不可思议了。

《经济学人》：这次经历中最出乎您意料的是什么？

奥基夫：它如此自然地融入了我的生活环境之中。由于我的身体状况，我们的房子里装有智能开关。因此，如果我坐在控制屏幕前，我就可以随心所欲地打开或关闭房子里任何地方的灯。我已经对孩子们做过几次了。这引起了他们的兴趣。

《经济学人》：这对您的日常生活、工作以及与他人的关系有何帮助？

奥基夫：嗯，说老实话，我的设备是第一代设备，是作为初始临床试验的一部分投入使用的。我是世界上第二个收到它的人。这个设备显然仍处于开发阶段。它让我能够使用电子邮件，使用WhatsApp之类的应用来滚动浏览各种网站并完成网上银行操作。我有了过正常的计算机生活的能力。所以，无论你在电脑上能做什么，我也都能做。目前我会比你慢一点，但如果我愿意，我几乎可以做任何事情。

植入这个设备时，我还在兼职工作。我可以使用它做一些线上的工作。我可以进入我公司的门户网站，更新信息并生成报告。

《经济学人》：您认为这个植入设备最棒的地方是什么？

奥基夫：从身体的角度来说，最棒的事情是你感觉不到它的存在。没有刺激。对我来说，这个设备已经成为我生活的一部分。这是一个非常无缝的过程。事实上，它让我恢复了独立生活的能力。从我的角度来看，毫无疑问，参与其中给了我活下去的理由。它让我重新获得了许多生活乐趣，让我有事可做，也能够与周遭正在发生的事情保持联系。

《经济学人》：关于脑机接口，您想告诉读者什么？

奥基夫：这是一个全新的世界。真的是这样。人脑是一个非常复杂的东西。在大脑和计算机之间建立直接联系，这只是人类进化道路上的又一步。你看，120年前我们不能飞行，而现在我们正在谈论把人送上火星。这是技术上的又一步。是的，我们需要对我们所做的事情小心慎重，但我们是人类，我们需要理解事物、学习事物。

《经济学人》：您觉得自己在什么方面得到增强了吗？

奥基夫：我感到增强了吗？我觉得自己像超人吗？不，我没有。但因为不幸生病而有机会参与这实验，我确实感到非常幸运。当我与人们交谈，看到他们惊讶地睁大眼睛时，我会感到自豪。我很高兴我所做的一切都是成功的。我很感激他们对我的关注。但我不认为自己是一个超级人类。我只是个参与了一个过程的人，能够和一些非常聪明的人一起论证一个概念并

证明它能行得通。而且它会变得更大，更好。■



Getting wired up

Crossing the brain's electrical frontier

New ways of getting inside patients' heads

THE STENT is a commonplace miracle. Every year millions of people around the world have their coronary arteries enlarged and reinforced by these life-saving little expandable tubes of mesh. The elect club of those who have had their whole worlds enlarged by “stentrodes”, on the other hand, numbers just three.

The stentrode is a routine stent, made from a flexible alloy called nitinol, to which an array of 16 laser-cut platinum electrodes has been added. It is inserted into the jugular vein in the neck and guided up into the brain, where surgeons guided by real-time X-rays snuggle it into a blood vessel running past the part of the cortex responsible for movement. A short lead runs back down the vein to a small powerpack and communications unit implanted in the chest. That base unit uses infrared light to send data to a receiver stuck on the skin, from which it passes to a computer.

The stentrode is not inside the grey matter of the brain, interacting directly with neurons: it remains in the blood vessel. But its electrodes pick up the electrical goings-on around them, and over time the patients can learn how to think thoughts that the computer takes as commands. Used in concert with systems that track eye movements the stentrode allows them to interact with the world using only eyes and thoughts.

Systems that can read brain waves are old hat. But if fitted non-invasively to the outside of the cranium they are cumbersome and relatively low in resolution; and sticking them into the brain proper requires surgeons to drill holes in the skull. The stentrode provides a skull-sparing way to get high-quality signals out of specific bits of the brain.

The appeal is obvious. In an increasingly computerised world, a brain-computer interface (BCI, also sometimes called a brain-machine interface) that lets the paralysed think words onto screens and tell apps, machines or eventually prosthetic limbs what to do could be of huge benefit. The stentrode is not the only device in the field; Neuralink, a company founded by Elon Musk, is looking at a system that would be inserted using cunningly automated surgery.

As readers of science fiction will be aware, the ultimate—if currently far-off—potential of such technologies could go well beyond medicine. There are a number of situations where being able to control things at a distance by mind alone might be a useful capacity for the currently able-bodied, too. The stentrode work, mostly carried out by researchers in Australia and commercially developed by Synchron, a company in America, has been partially funded by the Pentagon's far-out-ideas factory, DARPA.

BCIs are part of an emerging field of neural technology. The idea of stimulating the nerves for medical benefit can be traced back to antiquity, when Scribonius Largus, physician to the emperor Claudius, noted that electric fish could be beneficial to people in constant pain. In the modern era electroconvulsive therapy, first used in 1938, became a treatment for some serious forms of depression in the post-war decades. It fell out of favour after "One Flew Over the Cuckoo's Nest", a book that was made into a film, showed it in a darker light, and there are divergent opinions as to its efficacy. But it is still administered to around 1m patients a year, mostly for severe depression.

In the early 1960s deep brain stimulation (DBS) arrived. It uses electrical stimuli which vary by pulse width, voltage and frequency to treat Parkinson's, obsessive-compulsive disorder and epilepsy. As confidence in the therapy has grown it has been investigated as a treatment for other things, including cluster headaches, chronic pain, eating disorders,

Tourette's syndrome and treatment-resistant depression. It has advanced, recently, by offering "closed loop" forms that need no manual adjustment but are programmed to respond on the basis of electrophysiological biomarkers. Its appeal is limited, though, by the cost and difficulty of neurosurgery. Many Americans suffering from obsessive-compulsive disorder who might benefit from DBS cannot access it because of restrictions imposed by their insurers.

That DBS can get results has been clearly demonstrated. How it does so is less well understood. There is thus an emphasis on finding just the right place to stimulate. Scientists have rough ideas of where brain circuits for various functions are to be found and increasingly sophisticated imagining tools are adding ever more detail, which helps the technique. But the circuits differ greatly from person to person; searching for the sweet spot for the electrodes can take a lot of time and effort.

In some cases another option for targeting a troublesome bit of the brain can be simply to destroy—surgeons like to say ablate—it. Removing the bit of tissue where an epileptic person's seizures originate is a routine surgical approach in some severe cases of the disease. Here the exciting new twist is to make use of ultrasound. It can be focused powerfully enough on millimetre-sized targets deep in the brain to ablate them, and this can be done on a patient in an MRI, thus allowing surgeons to see what they are doing with their sound scalpel in the dark depths beneath a completely intact skull. The technique has already been used to treat some types of brain tumour. It is being investigated for anxiety, depression, epilepsy, intracerebral haemorrhage, movement disorders and pain.

Another promising neuropsychiatric use of ultrasound is in tackling the blood-brain barrier. The body keeps this demarcation line tight, stopping almost all the things found in the blood stream, including a lot of drugs, from getting in among the neurons. Sometimes this is a good thing.

Loperamide (Imodium), widely used to control diarrhoea, has stronger effects on the brain's opioid receptors than its relative morphine does, but it is much less good at crossing the blood-brain barrier. But the barrier also means there are drugs that might do a lot of good in the brain but cannot get there. It appears that ultrasound may be a practical way of disrupting the blood-brain barrier for limited periods and in specific places. It might thus offer a way to open portals into realms to which drugs would not otherwise have access.

Part of the charm of ultrasound is that it does not require making holes in the skull. Transcranial magnetic stimulation (TMS) has the same advantage. An electromagnetic coil is placed against the scalp to generate magnetic fields to which nerve cells are sensitive. High-frequency stimulation increases the cortical excitability, while low-frequency stimulation depresses it.

At present TMS is mostly being used against depression, which is thought to stem in part from poor neural connections in the prefrontal cortex. A particularly precise version of the therapy uses MRI scans to allow the therapy to be used on the part of the prefrontal cortex which should have connectivity to the subgenual cingulate—a part of the brain that plays a role in processing emotions, and is a target aimed at by DBS approaches to depression.

Beyond this, though, TMS is also being studied for application in the usual suspects, such as anxiety, pain, OCD, PTSD, Tourette's and other movement disorders. It may have other applications, too. Frances Jensen, a professor of neurology at the University of Pennsylvania says that when a stroke victim is trying to regain speech, adding TMS to normal speech therapy can "supercharge" the circuits they are trying to get back.

| *Mind meets brain*

The idea of therapy acting through the conscious mind being improved by magnets stimulating the brain below brings home one of the things that is remarkable about the current era of neuroscience and medicine. The workings of the mind and the subvening brain are still suffused by mystery; but science is offering new ways to intervene in them which can be used, and combined, to good effect. Drugs and neuromodulation are not alternatives; therapy and psychedelics can work in tandem. Just as neuroscience now learns from optogenetics, organoids and AI as well as its older techniques, precision neuromedicine will be a calling that uses not just many tools but many different types of tool.

Too much of the 20th-century history of psychiatry was a history of either/or; some proponents of talking cures have derided drugs as chemical coshes, some pharmaceutical devotees have struggled to see any sense in explanations that go beyond the workings of synapses. The drive towards specificity documented in this report look like showing this is a false dichotomy. The bottom-up approaches which target the molecular, genetic and electrical fundamentals of the brain can assist top-down approaches to brain disorder such as talking therapies. Understanding the roots of neurodegenerative diseases before they begin to produce symptoms—roots which may reach back decades into young adulthood or earlier—should lead not just to better drugs, but to insights into how to lead lives in which those roots never get to sprout and bear their morbid fruit.

The ancient dictum that “healthy bodies produce healthy minds” is not universally true. The fact that bodily health can underpin mental health, though, is undoubted. Brains are influenced by nutrition, physical exercise, use of alcohol and other drugs, social connections and pollution (particularly, these days, air pollution). Pre-natal exposure to pollution, for example, is likely to play a role in some early developmental disorders. Exposure later in life could play a role in dementias. A new trial shows that

taking a common multivitamin over three years leads to an improvement in memory and cognition, underlining the role of nutrition. Human brains are the key to the wealth of any society, as well as its future. Doing a better job of taking care of them deserves a little more headspace.

And the effort to do so through deeper understanding deserves celebration. The human brain is an organ of truly remarkable complexity, and there is perhaps no measure of that complexity more impressive than the fact that the human minds which those brains produce are making real progress in understanding it. Human brains have begun an epic journey of self-discovery. ■



连接起来

穿越大脑的电子前沿

进入患者大脑的新方法【专题《修复大脑》系列之二】

支架是一个司空见惯的奇迹。每年，全世界有数百万人的冠状动脉被这些挽救生命的小小的可膨胀网状管扩张和加固。另一方面，有些人的整个世界都被“stentrodes”拓展，这个精英俱乐部却只有三人。

Stentrode就是一个常规支架，由名为镍钛诺的柔性合金制成，但其中添加了16个激光切割的铂电极阵列。它被插入颈部的颈静脉并向上引导进入大脑，在实时X光的引导下，外科医生将其贴在穿过负责运动的皮层部分的血管中。一条短导线沿静脉返回到植入胸部的小型电源组和通信单元。这个基站使用红外光将数据发送到贴在皮肤上的接收器，然后从接收器传送到计算机。

Stentrode并不在大脑的灰质内直接与神经元相互作用：它依然在血管中。但是它的电极会接收到周围的电流，随着时间的推移，患者可以学会能让计算机接收为命令的思考方式。与跟踪眼球运动的系统配合使用时，stentrode让患者可以仅使用眼睛和思想与世界互动。

可以读取脑电波的系统已经屡见不鲜。但是，如果非侵入性地安装在颅骨外侧，它们会很笨重且分辨率相对较低；将它们正确地插入大脑需要外科医生在头骨上钻孔。Stentrode提供了一种免去开凿颅骨的方法，可以从大脑的特定部位获取高质量的信号。

吸引力是显而易见的。在一个日益计算机化的世界中，脑机接口（BCI）可以让瘫痪的人通过思考把文字打在屏幕上，并告诉应用程序、机器或最终告诉假肢该做什么，这可能会带来巨大的好处。Stentrode不是该领域唯一的设备。由伊隆·马斯克创立的Neuralink公司正在研究一种可以通过巧妙的自动化手术插入的系统。

科幻小说的读者都知道，这种技术的最终（虽然可能目前还很遥远）潜力可能远远超出医学范畴。在一些情况下，仅凭意念就能远距离控制事物，对目前身体健康的人来说可能也是一种有用的能力。Stentrode的研发主要由澳大利亚的研究人员进行，由美国的Synchron公司负责商业开发，部分资金来自五角大楼的先锋创意工厂DARPA。

BCI属于新兴的神经技术领域。为医疗目的刺激神经的想法可以追溯到古代，给克劳狄一世治病的医生斯克里波尼乌斯·拉杰斯（Scribonius Largus）指出，电鱼可能对常年忍受疼痛的人有益。在现代，电休克疗法于1938年被首次使用，在战后几十年中成为治疗某些严重抑郁症的方法。在小说《飞越疯人院》（One Flew Over the Cuckoo's Nest，后被拍成电影）对它做了暗黑的描画后，这种方法就失宠了，它的功效如何目前众说纷纭。但每年仍有大约100万名患者接受该疗法，主要是针对严重抑郁症。

在1960年代初期，深部脑刺激（DBS）出现了。它实施的电刺激会调整脉冲宽度、电压和频率来治疗帕金森氏症、强迫症和癫痫症。随着人们对该疗法的信心增强，它已被研究用于治疗其他疾病，包括丛集性头痛、慢性疼痛、饮食失调、图雷特综合症和难治性抑郁症。最近它的进展是“闭环”形式，这种形式不需要手动调整，而是经过编程以根据电生理生物标志物做出反应。然而，它的吸引力受限于神经外科手术的成本和难度。由于保险公司施加的限制，许多可能从DBS受益的患有强迫症的美国人无法使用它。

DBS能够取得疗效已经被明确证明，但它是如何做到这一点的还不太清楚。因此，重点是找到合适的位置进行刺激。科学家们对在哪里可以找到各种功能的大脑回路有粗略的见解，并且越来越复杂的成像工具正在添加更多细节，这有助于推进这项技术。但是脑回路的个体差异极大。寻找植入电极的最佳位置可能需要花费大量时间和精力。

在某些情况下，针对大脑中问题部位的另一种选择可能是简单地摧毁它——外科医生喜欢说“消融”它。在一些严重的癫痫病例中，去除患者脑中

致癫痫发作的组织是一种常规手术方法。这里令人兴奋的新转折是利用超声波。它可以足够强大地聚焦在大脑深处毫米大小的目标上以消融它们，这可以在核磁共振（MRI）下对患者实施，从而使外科医生能够看到，在完好无损的头骨之下的黑暗深处，他们的声波手术刀正在做些什么。该技术已被用于治疗某些类型的脑肿瘤。它正在被研究用于焦虑、抑郁、癫痫、脑出血、运动障碍和疼痛。

超声波的另一个有前途的神经精神用途是攻克血脑屏障。身体把这条分界线划得很清楚，几乎阻止了血液中发现的所有东西——包括很多药物——进入神经元之间。有时这是一件好事。广泛用于控制腹泻的洛哌丁胺（Imodium）对大脑的阿片受体的作用比它的近亲吗啡强，但远不像吗啡那样容易穿过血脑屏障。但这道屏障也意味着有些可能对大脑有很多好处的药物无法抵达那里。超声波看起来可能是一种在有限时段和特定位置破坏血脑屏障的实用方法。因此，它可能会提供一种方法来打开通往药物无法进入的领域的门户。

超声波的部分魅力在于它不需要在颅骨上打洞。经颅磁刺激（TMS）具有同样的优势。将电磁线圈放置在头皮上以产生神经细胞敏感的磁场。高频刺激增加皮质兴奋性，而低频刺激会抑制它。

目前，TMS主要用于治疗抑郁症，这种疾病被认为部分源于前额叶皮层中的不良神经连接。该疗法的一个特别精确的版本使用MRI扫描来对准前额叶皮层的一个本应与膝下扣带回相连的部分。膝下扣带回是大脑中负责处理情绪的部分，也是抑郁症DBS治疗的一个靶点。

不过，除此之外，TMS也正被研究用于治疗常见的病症，如焦虑、疼痛、强迫症、创伤后应激障碍、图雷特氏症和其他运动障碍。它也可能有其他应用。宾夕法尼亚大学神经学教授弗朗西斯·詹森（Frances Jensen）说，当中风患者试图恢复言语功能时，在他们通常接受的言语治疗中加入TMS可以“增强”他们试图恢复的回路。

| 当心智遇上大脑

用磁体刺激大脑的方法升级了通过清醒的头脑产生效力的治疗思路，凸显了当下神经科学和医学时代的非凡之处之一。心智的运作方式及其背后的大脑仍然充满神秘色彩。但科学正在提供新的干预它们的手段，这些方法可以单独使用或结合起来使用，效果很好。药物和神经调节不能相互替代；治疗和致幻剂可以协同工作。正如神经科学现在从光遗传学、类器官和人工智能以及更古老的方法中学习一样，精准神经医学这个科室将运用许多工具，而且是许多不同类型的工具。

20世纪的精神病学史充斥了太多非此即彼的论调；一些谈话疗法的支持者嘲笑药物是化学镇静剂，一些药物爱好者则看不到突触工作原理之外的解释有任何意义。本专题中记录的对特异性的追求似乎表明这是一种错误的二分法。自下而上的方法针对大脑的分子、遗传和电学基础，可以协助那些自上而下的方法（如谈话疗法）来治疗脑疾病。在神经退行性疾病开始产生症状之前了解它们的根源——可能可以上溯几十年至青少年时期甚至更早——不仅应该会带来更好的药物，还有助于了解如何生活能让这些根茎永不发芽和结出坏果子。

“健康的身体产生健康的心灵”的古老格言并不普遍正确。然而，身体健康可以支撑心理健康这一事实是毋庸置疑的。大脑受到营养、体育锻炼、酒精和其他药物的使用、社会关系和污染（尤其是现在的空气污染）的影响。例如，产前暴露于污染可能会导致一些早期发育障碍。晚些时候接触污染可能会导致痴呆症。一项新的试验表明，连续三年服用一种普通的复合维生素可以改善记忆力和认知能力，这凸显了营养的作用。人脑是任何社会财富及其未来的关键。更好地照顾它们的工作应该得到更多重视。

通过更深入的理解来实现这一目标的努力值得表彰。人脑是一个极其复杂的器官，而其复杂性的体现也许莫过于这些大脑所产生的人类思维正在理解这种复杂性上取得真正的进步。人类的大脑已经开始了一段史诗般的自我发现之旅。■



After the chaos

A new macroeconomic era is emerging. What will it look like?

A great rebalancing between governments and central banks is under way

FOR MONTHS there has been turmoil in financial markets and growing evidence of stress in the world economy. You might think that these are just the normal signs of a bear market and a coming recession. But they also mark the painful emergence of a new regime in the world economy—a shift that may be as consequential as the rise of Keynesianism after the second world war, and the pivot to free markets and globalisation in the 1990s. This new era holds the promise that the rich world might escape the low-growth trap of the 2010s and tackle big problems such as ageing and climate change. But it also brings acute dangers, from financial chaos to broken central banks and out-of-control public spending.

The ructions in the markets are of a magnitude not seen for a generation. Global inflation is in double digits for the first time in nearly 40 years. Having been slow to respond, the Federal Reserve is now cranking up interest rates at the fastest pace since the 1980s, while the dollar is at its strongest for two decades, causing chaos outside America. If you have an investment portfolio or a pension, this year has been gruesome. Global shares have dropped by 25% in dollar terms, the worst year since at least the 1980s, and government bonds are on course for their worst year since 1949. Alongside some \$40trn of losses there is a queasy sense that the world order is being upended as globalisation heads into retreat and the energy system is fractured after Russia's invasion of Ukraine.

All this marks a definitive end to the age of economic placidity in the 2010s. After the global financial crisis of 2007-09 the performance of rich economies assumed a feeble pattern. Investment by private firms was subdued, even at those making monster profits, while governments did not

take up the slack: the public capital stock actually shrank around the world, as a share of GDP, in the decade after Lehman Brothers collapsed. Economic growth was sluggish and inflation was low. With the private and public sectors doing little to stimulate more activity, central banks became the only game in town. They held interest rates at rock-bottom levels and bought huge volumes of bonds at any sign of trouble, extending their reach ever further into the economy. On the eve of the pandemic central banks in America, Europe and Japan owned a staggering \$15trn of financial assets.

The extraordinary challenge of the pandemic led to extraordinary actions which helped unleash today's inflation: wild government stimulus and bail-outs, temporarily skewed patterns of consumer demand and lockdown-induced supply-chain tangles. That inflationary impulse has since been turbocharged by the energy crunch as Russia, one of the largest exporters of fossil fuels along with Saudi Arabia, has isolated itself from its markets in the West. Faced with a serious inflation problem the Fed has already raised rates from a maximum of 0.25% to 3.25% and is expected to take them to 4.5% by early 2023. Globally, most monetary authorities are tightening too.

What on earth comes next? One immediate fear is of a blow-up, as a financial system that has become habituated to low rates wakes up to the soaring cost of borrowing. Although one mid-sized lender, Credit Suisse, is under pressure, it is unlikely that banks will become a big problem: most have bigger safety buffers than in the past. Instead the dangers lie elsewhere, in a new-look financial system that relies less on banks and more on fluid markets and technology. The good news is that your deposits are not about to go up in smoke. The bad news is that this system for financing firms and consumers is opaque and hypersensitive to losses.

You can already see this in the credit markets. As firms that buy debt shy away from risk, the interest rate on mortgages and junk bonds is soaring.

The market for “leveraged loans” used to finance corporate buy-outs has seized up—if Elon Musk buys Twitter the resulting debts may become a big problem. Meanwhile investment funds, including pension schemes, face losses on the portfolios of illiquid assets they have accumulated. Parts of the plumbing could stop working. The Treasury market has become more erratic while European energy firms have faced crushing collateral calls on their hedges. Britain’s bond market has been thrown into chaos by obscure derivatives bets made by its pension funds.

If markets stop working smoothly, impeding the flow of credit or threatening contagion, central banks may step in: already the Bank of England has done a U-turn and started buying bonds again, cutting against its simultaneous commitment to raise rates. The related belief that central banks will not have the resolve to follow through on their tough talk is behind the other big fear: that the world will return to the 1970s, with rampant inflation. In one sense this is alarmist and over the top. Most forecasters reckon inflation in America will fall from the present 8% to 4% in 2023 as energy price-rises ebb and higher rates bite. Yet while the odds of inflation going to 20% are tiny, there is a glaring question about whether governments and central banks will ever bring it back down to 2%.

| *A moving target*

To understand why, look beyond the hurly-burly to the long-term fundamentals. In a big shift from the 2010s, a structural rise in government spending and investment is under way. Ageing citizens will need more health care. Europe and Japan will spend more on defence to counter threats from Russia and China. Climate change and the quest for security will boost state investment in energy, from renewable infrastructure to gas terminals. And geopolitical tensions are leading governments to spend more on industrial policy. Yet even as investment rises, demography will weigh ever more heavily on rich economies. As people get older they save

more, and this excess of savings will continue to act to depress the underlying real rate of interest.

As a result the fundamental trends in the 2020s and 2030s are for bigger government but still-low real interest rates. For central banks this creates an acute dilemma. In order to get inflation down to their targets of roughly 2% they may have to tighten enough to cause a recession. This would incur a high human cost in the form of job losses and trigger a fierce political backlash. Moreover, if the economy deflates and ends up back in the low-growth, low-rate trap of the 2010s, central banks may once again lack enough stimulus tools. The temptation now is to find another way out: to ditch the 2% inflation targets of recent decades and raise them modestly to, say, 4%. That is likely to be on the menu when the Fed begins its next strategy review in 2024.

This brave new world of somewhat higher government spending and somewhat higher inflation would have advantages. In the short run it would mean a less severe recession or none at all. And in the long run it would mean that central banks have more room to cut interest rates in a downturn, reducing the need for bond-buying and bail-outs whenever anything goes wrong, which cause ever-greater distortion of the economy.

Yet it also comes with big dangers. Central banks' credibility will be damaged: if the goalposts are moved once, why not again? Millions of contracts and investments written on the promise of 2% inflation would be disrupted, while mildly higher inflation would redistribute wealth from creditors to debtors. Meanwhile, the promise of moderately bigger government could easily spiral out of control, if populist politicians make reckless spending pledges or if state investments in energy and industrial policy are poorly executed and morph into bloated vanity projects that drag down productivity.

These opportunities and dangers are daunting. But it is time to start weighing them and their implications for citizens and businesses. The biggest mistakes in economics are failures of imagination that reflect an assumption that today's regime will last for ever. It never does. Change is coming. Get ready. ■



【首文】混乱之后

一个新的宏观经济时代正在浮现。它会是什么样子？

政府和央行之间正在进行一场宏大的再平衡

数月来，金融市场动荡不安，全球经济承压的证据越来越多。你可能认为这些只是熊市和即将出现衰退的常见迹象。但它们也标志着全球经济将在痛楚中迎来一个新体系，这次转变的影响之重大可能堪比二战后凯恩斯主义的兴起，以及上世纪90年代向自由市场和全球化的转向。这个新时代有望让富裕世界摆脱2010年代的低增长陷阱、解决老龄化和气候变化等重大问题。但它也带来了金融混乱、央行失灵以及公共支出失控等严重危险。

市场的动荡程度为近二三十年之最。全球通胀近40年来首次突破两位数。美联储起初反应迟缓，现在正以上世纪80年代以来最快的速度加息，同时美元冲上了20年来的最高位，在美国以外的地区造成了混乱。如果你持有投资组合或养老金，今年的回报可谓惨淡。以美元计算，全球股市下跌了25%，是至少自80年代以来最糟的一年；政府债券以目前的走势将经历自1949年以来最糟的一年。约40万亿美元的财富蒸发，与此同时，随着全球化开始倒退，加上俄罗斯入侵乌克兰破坏了能源体系，人们也不安地感到世界秩序正在被颠覆。

所有这些明确标志着2010年代的经济平静期已经终结。在2007至2009年全球金融危机之后，富裕经济体的表现疲弱无力。私营公司的投资受到抑制，即使是那些在赚取巨额利润的公司也是如此，而政府也没能填补空白。在雷曼兄弟倒闭后的十年里，全球公共资本存量占GDP的比重实际上缩减了。经济增长乏力，通胀率低。私营和公共部门在刺激更多经济活动方面无所作为，央行就成了唯一的指靠。它们将利率维持在最低水平，一有风吹草动就大举购债，令自己的触角不断深入经济。在新冠疫情暴发前夕，美国、欧洲和日本的央行的金融资产总计达到惊人的15万亿美元。

疫情带来的非常挑战导致了非常的举措和行为：政府出台疯狂的经济刺激和救助措施，消费者需求模式一时扭曲，防疫封锁导致供应链一团糟。所

有这些触发了今天的高通胀。此后，随着和沙特阿拉伯同为全球最大化石燃料出口国之一的俄罗斯自我隔绝于西方市场，能源的紧缺进一步加剧了通胀。面对严重的通胀问题，美联储已经将利率从之前最高0.25%上调到3.25%，预计到2023年初将达到4.5%。在全球范围内，大多数央行也都在收紧政策。

接下来究竟会如何？最直接的担忧是，已经习惯了低利率的金融体系突然面临借贷成本飙升，会引发系统性崩盘。尽管瑞信这家中型银行正在承压，但整个银行业不太可能会出现大问题，因为大多数银行都具备比过去更充分的安全缓冲。危险倒是潜藏在别处：一个新面目的金融体系，它不那么依赖银行，而更多地依赖流动市场和科技。好消息是你的存款不会化为乌有。坏消息是这个为公司和消费者提供融资的系统透明度低，而且对损失非常敏感。

这一点已经在信贷市场显露端倪。由于购债的公司规避风险，抵押贷款和垃圾债券的利率正在飙升。为企业收购提供资金的“杠杆贷款”市场已骤然失灵，如果马斯克收购推特，由此产生的债务可能会成为一个大问题。与此同时，包括养老金计划在内的投资基金过去积累的流动不佳的资产组合面临亏损。金融市场的部分“管道”可能会堵塞。国债市场变得更加不稳定，而欧洲能源公司则面临着大量追加对冲抵押的要求。英国的债券市场已因其养老基金不透明的衍生品押注陷入混乱。

如果市场不再顺畅运转，阻碍了信贷的流通或者有导致危机蔓延的风险，央行可能会出手干预。英国央行的政策已经180度大转弯，开始重新购债，与它自己同时期对加息的承诺背道而驰。这让人认为央行不会下定决心去贯彻自己的强硬言论，而这又让人生发出另一个重大担忧：世界将回到通胀猖獗的1970年代。从某种意义上说，这种担忧言过其实，危言耸听。大多数预测机构认为，随着能源价格回落以及加息的作用开始显现，到2023年美国的通胀将从目前的8%下降到4%。然而，尽管通胀升至20%的可能性很小，但政府和央行是否会把它降至2%却是一个不容忽视的问题。

| 可调整的目标

要了解其中原因，就要透过表面的喧扰看到长期基本面。目前政府支出和投资正在发生结构性增长，这是从2010年代路径的大掉头。老龄化的人口将需要更多的医疗保健服务。欧洲和日本将加大国防投入以应对来自俄罗斯和中国的威胁。气候变化和对安全的追求将推动各国加大对能源的投资，包括可再生能源基础设施和天然气终端。地缘政治局势紧张，导致政府加大产业政策的投入。然而，在投资增加的同时，人口结构的变化对富裕经济体的影响仍将越来越大。人们年龄越大越爱存钱，而这种过度储蓄将继续压低实际利率。

因此，2020年代和2030年代的基本趋势是政府扩大干预，但实际利率仍然很低。这令央行面临左右为难的棘手困境。为了实现将通胀降至2%左右的目标，它们可能不得不把货币政策收紧到足以引发经济衰退的程度。这将导致失业、损害民生，并引发激烈的政治冲击。此外，如果经济出现紧缩，并最终重新陷入2010年代低增长、低利率的陷阱，央行可能会再次缺乏足够的刺激工具。现在面临的诱惑是另寻出路：放弃近几十年来2%的通胀目标，将其适度提高，比如提高到4%。美联储在2024年开始新一轮策略评估时很可能会考虑这项调整。

这个政府支出适度增加、通胀也适度提高的勇敢新世界会带来些好处。短期内，这将意味着经济不会严重衰退，或根本不会出现衰退。长期来看，这意味着央行在经济低迷期有更大的降息空间，这样就不至于一出现问题就又要买债和纾困，避免越来越多地扭曲经济。

然而，这也伴随着巨大的风险。央行的信誉将受损。既然通胀目标能改一次，那为何不会改第二次？数以百万计的基于2%通胀承诺的合同和投资将受到冲击，而更高一些的通胀将把财富从债权人重新分配给债务人。与此同时，如果民粹主义政客做出不计后果的支出承诺，或者政府对能源和产业政策的投资执行不力，沦为拖累生产率的形象工程，那么“适度大政府”的承诺也很容易失控。

这些机遇和危险都令人生畏。但现在是时候开始权衡其中的利弊及其对公

民和企业的影响了。经济学中最大的错误就是缺乏想象力——人们以为今天的机制将永远持续。模式从不是一成不变的。变化即将来临，请做好准备。 ■



The Economist Film

How are offices changing? Part 2

There could also be losers from the hybrid office revolution.



经济学人视频

未来办公室什么样？（下）

混合办公革命也可能造就输家。



Asteroseismology

Want to know what's inside a star? Listen closely

Sounds from stars are proving useful to astronomers

IN THE 1960S astronomers discovered that the Sun was pulsating—expanding and contracting regularly every five minutes. As well as this main oscillation, they later found millions more, each with a unique rhythm. The oscillations were the result of pressure waves that had been bouncing around inside the Sun. As such, they carried with them valuable information about the gases and conditions inside the star. Just as geologists used seismic waves caused by earthquakes to glean information about the rocky innards of Earth, astronomers began to use “sunquakes” to take a peek inside the nearest star.

By “listening” to sound waves from the Sun, “helioseismology” has since allowed astronomers to work out the structure and dynamics of the star’s interior. New observatories are now extending this technique to stars beyond the solar system. “Asteroseismology” will give astronomers a glimpse of the interiors of faraway stars and also help them understand how the Milky Way, the Earth’s galaxy, has evolved.

As seismic waves move through the Earth, they are affected by the materials through which they travel. The speed of these waves, for example, is linked to the temperature, density and chemical composition of the rocks in the core and mantle. Acoustic waves travelling through stars are similarly affected by the composition of materials they encounter.

| *Not just a ball of hot gas*

At the centre of the Sun is a core in which nuclear fusion takes place; surrounding that is the “radiative zone” where energy is transported via radiation and thermal conduction. Beyond that is the “convection zone”

where rising and descending bubbles of plasma create an unstable regime (see diagram).

This turbulence is the source of the acoustic waves that give rise to the Sun's oscillations. While the seismic waves generated by an earthquake usually come from a point source in the Earth's crust, the Sun's oscillations are triggered by countless disturbances occurring throughout its convection zone. Like a bell, the Sun is continually ringing with the tones and overtones of the millions of oscillations.

The waves have been a useful way to accurately measure the Sun's age. By tracking the variations in the speed of the acoustic waves inside the Sun, it was possible to infer the changes in density in the interior of the Sun. From that astronomers worked out how much helium and hydrogen exists in the star. Helium is created by the fusion of hydrogen nuclei in the Sun's core (a process that makes all stars shine), and measuring the quantities of those elements confirmed that the Sun was 4.6bn years old, matching the ages of the oldest meteorites found on Earth (the other tried and tested way to measure the age of the solar system and, hence, the Sun).

By the end of the 20th century, the Sun's acoustic waves had also helped solve a longstanding conundrum with the flux of solar neutrinos, a type of fundamental particle created in the fusion reactions at the hearts of stars. For decades there had been a puzzling mismatch between the number of neutrinos coming from the Sun, as measured by astronomers, and the number of neutrinos predicted by particle physicists. Seismological measurements showed that there was nothing wrong with astronomers' models of how the Sun worked. Particle physicists were then forced to revise their theories about neutrinos, which they had long thought were massless particles. Neutrinos, they concluded, must in fact have a tiny amount of mass and be able to transform from one type to another as they travelled from the Sun to the Earth. This was confirmed experimentally in

2002.

| *Into the unknown*

These successes gave helioseismologists confidence to broaden their horizons. By measuring how much and how fast the surfaces of faraway stars were moving inward or outward, Jørgen Christensen-Dalsgaard, an astrophysicist at Aarhus University in Denmark, was one of the first to detect seismic oscillations in another star—a binary system 37 light years away from Earth—in 1995. But progress on stars beyond the solar system was painfully slow. In order to record just a handful of stellar oscillations in a massive star ten times heavier than the Sun and located 690 light years away from Earth, Conny Aerts, an astrophysicist at KU Leuven, a university in Belgium, had to collate data from two decades of observations that stretched back to the early 1980s.

Fortunately, Dr Aerts and her colleagues will not have to toil so hard in the future. Help (and lots of data) for asteroseismologists is flooding in from an allied branch of astronomy—the hunt for exoplanets. Looking for planets beyond the solar system requires watching faraway stars for long periods of time and looking for slight changes in their luminosity. These changes can come either from planets transiting across the stars or from oscillations in the stars themselves. Exoplanet observatories such as COROT, launched by the French and European space agencies, and Kepler, built by NASA, have monitored thousands of stars in recent years with unprecedented precision. The data these missions have gathered has been a gold mine for asteroseismologists, who have used it to examine hundreds of Sun-like stars and several thousand red giants.

After this frenzy of activity, the details of many stars have been updated. A team of French astronomers, for example, recently found that Altair, a fast-rotating, bright star 17 light years away in the constellation Aquila, was only 100m years old, rather than 1bn years as previously thought. They used

asteroseismological data from watching fluctuations of Altair's luminosity, which were in turn caused by the oscillations, and thus the pressure waves, inside the star. In August a team of astronomers updated the age of the binary star 12 Boötis, which was observed by NASA's Transiting Exoplanet Survey Satellite (TESS) observatory. Writing in the journal *Monthly Notices of the Royal Astronomical Society*, researchers calculated the star's age at 2.67bn years, with a margin of error less than 160m years, or 6%. Traditional dating methods have uncertainties far above 10%. Data from Kepler also revealed strong magnetic fields inside the cores of three red giant stars, situated near the constellations Cygnus and Lyra, each a few thousand light years away.

TESS will continue to provide asteroseismologists with new data, but even better instruments are on their way. The European Space Agency will launch a new exoplanet hunter, PLATO, in 2026. It will not only monitor hundreds of thousands of Sun-like stars but keep its eyes on tens of thousands of massive stars too.

Though massive stars that are at least eight times heavier than the Sun are a minority in the galaxy, astronomers have a special interest in them. They enrich interstellar environments with heavy elements when they die as supernovae. These remnants are chemical clues that can help to reconstruct the history of the Milky Way. Elements lighter than iron are produced in the cores of massive stars as they burn; heavier elements are created in supernova explosions. Understanding which elements are inside a star, through asteroseismology measurements, can reveal to which generation that star belongs, and so from how many predecessor stars it has been recycled. The Sun, for example, is thought to be a third-generation star, which means it originated from material from a previous star that already was enriched with heavy elements from another predecessor, probably a massive star that ended in a supernova.

“If we want to understand how the Milky Way was assembled, we need to know how each generation of stars behaved,” says Chris Lintott, an astrophysicist at Oxford University. “Understanding stellar evolution in detail is the next step in putting together the history of our galaxy.” ■



星震学

想知道恒星内部有什么吗？仔细听

来自恒星的声音对天文学家很有用【新知】

上世纪60年代，天文学家发现太阳每五分钟就会一胀一缩有规律地“脉动”一次。除了这个最主要的震荡，他们后来还发现了无数个震荡，每一个都有自己独特的节律。这种震荡是由太阳内部不断翻腾四起的压力波造成的，因此它们携带了有关太阳内部气体和状况的宝贵信息。正如地质学家利用地震引发的地震波来收集有关地球内部岩石结构的信息一样，天文学家开始利用“日震”来窥探这颗离我们最近的恒星的内部。

由此而生的“日震学”通过“聆听”来自太阳的声波，让天文学家弄清太阳内部的结构和动态。如今，新型的天文探测器正在利用这种手段观测太阳系以外的恒星。“星震学”将让天文学家一窥遥远的恒星内部，并帮助他们了解地球所在的星系——银河系的演化过程。

地震波在地层中传播时会受到途经物质的影响。例如，地震波的速度与地核和地幔中岩石的温度、密度及化学成分有关。同样，声波在恒星中传播时也受到所遇物质成分的影响。

| 不仅是一团热气

太阳的中心是日核，核聚变在这里发生；它的周围是“辐射区”，能量在这里通过辐射和热传导传输。辐射区外面是“对流区”，上下翻腾的等离子体气泡让这里成为一个不稳定的区域（见图表）。

对流区的乱流产生了声波，而声波又引发了太阳的震荡。地震产生的地震波通常源自地壳中的一个点，而太阳的震荡则是由遍布其对流区的无数湍流引发的。太阳就像一口钟一样，在无穷次的震荡中不停地发出基音和泛音。

利用声波一直是精确测量太阳年龄的有效方法。通过追踪太阳内部声波速

度的变化，就有可能推断出太阳内部密度的变化。由此，天文学家计算出了太阳中氦和氢的含量。氦是由太阳核心的氢核聚变产生的（所有恒星发光都是因为这一过程），通过测量这些元素的量，确定了太阳的年龄为46亿岁，与地球上发现的最古老的陨石年龄相当（研究地球上的陨石是另一种测定太阳系年龄并由此测定太阳年龄的可靠方法）。

到20世纪末，太阳的声波还帮助解决了一个长期存在的谜题，与太阳中微子的通量有关。中微子是恒星中心聚变反应产生的一种基本粒子。几十年来一直令人不解的是，天文学家测量到的来自太阳的中微子数量与粒子物理学家预测的中微子数量有出入。日震测量结果表明，天文学家创建的太阳运行方式模型没有任何问题。于是粒子物理学家不得不修正了自己关于中微子的理论。之前他们一直认为中微子是没有质量的粒子，现在他们总结道，中微子实际上肯定有着很小的质量，并且能在从太阳抵达地球的过程中从一种形态转变为另一种形态。这在2002年得到了实验证实。

| 探入未知

这些成功让日震学家们有了拓宽研究视野的信心。1995年，丹麦奥尔胡斯大学（Aarhus University）的天体物理学家约根·克里斯滕森-达尔斯加德（Jørgen Christensen-Dalsgaard）测量到了遥远恒星表面胀缩运动的幅度和速度，成为率先探测到另一颗恒星（一个距离地球37光年的双星系统）震荡的人之一。但是太阳系外恒星的研究进展非常缓慢。仅仅为了记录一颗质量为太阳十倍、距离地球690光年的大质量恒星的少许星震，比利时鲁汶大学（KU Leuven）的天体物理学家康尼·埃尔茨（Conny Aerts）不得不收集了自上世纪80年代初开始的20年的观测数据。

幸运的是，今后埃尔茨和她的同事将不必那么辛苦了。天文学一个相关的分支——系外行星探测正源源不断地为星震学家提供帮助（和大量数据）。寻找系外行星需要对遥远的恒星进行长时间观察，并寻找它们光度的细微变化。这些变化可能是行星掠过恒星时造成的，也可能来自恒星本身的震荡。近年来，法国和欧洲的航天机构部署的COROT以及美国国家航空航天局（NASA）打造的开普勒（Kepler）等系外行星观测计划以前所未有的精确度监测了数千颗恒星。这些任务收集到的数据对星震学家来说可

谓一座宝库，他们利用这些数据研究了数百颗类日恒星和数千颗红巨星。

在这一轮热火朝天的数据分析过后，许多行星的详细信息都得到了更新。例如，一个法国天文学家小组最近发现，牵牛星的年龄只有一亿年，而不是之前认为的十亿年。牵牛星位于天鹰座中，距离地球17光年，是一颗自转很快的明亮的恒星。他们使用的星震数据来自对牵牛星光度波动的观测，而光度波动是由其内部的震荡也就是压力波引起的。今年8月，一个天文学家小组更新了双星牧夫座12的年龄，这是NASA的凌日系外行星勘测卫星（TESS）的观测结果。研究人员在英国《皇家天文学会月刊》（Monthly Notices of the Royal Astronomical Society）发表的文章中写道，他们计算出这颗恒星的年龄为26.7亿年，误差不到1.6亿年，即小于6%。而传统定年法的不确定度远高于10%。来自开普勒的数据还显示，在距离我们几千光年的天鹅座和天琴座附近，有三颗红巨星的核心都存在强磁场。

TESS将继续为星震学家提供新的数据，但比它更先进的仪器也即将登场。欧洲航天局将于2026年发射一架新的系外行星观测器柏拉图（PLATO）。它不仅能监测几十万颗类日恒星，还会密切关注成千上万的大质量恒星。

虽然质量至少为太阳八倍的大质量恒星在银河系中不多见，天文学家对它们有着特殊的兴趣。当它们以超新星的形式消亡时，会产生重元素进入星际环境。这些残留物的化学成分可以帮助重现银河系的历史。大质量恒星燃烧时，其核心会产生比铁轻的元素；在超新星爆发时，会产生更重的元素。通过星震学测量了解恒星内部的元素可以揭示这颗恒星属于哪一代，从而知道它循环利用了多少颗前世恒星的物质。例如，太阳被认为是第三代恒星，也就是说它的物质来源于第二代恒星，而这第二代恒星中已经含有来自第一代恒星的重元素，第一代可能是一颗以超新星告终的大质量恒星。

“如果我们想了解银河系是如何形成的，就需要知道每一代恒星的活动。”牛津大学的天体物理学家克里斯·林特（Chris Lintott）表示，“详细了解恒星的演化是拼接出我们银河系的历史的下一步。”■



Precision neuromedicine

Better brain biology will deliver better medicines

Insights from organoids and optogenetics help

A BROKEN BRAIN, hidden inside a skull, is harder to diagnose than a broken leg. The fact that there is somebody inside the skull to tell doctors how they feel might seem to offer a way round this. But the feelings patients describe are not easily mapped on to the brain. Definitions of mental diseases are vague. “Major depressive disorder and generalised anxiety have an 80% overlap in disease definitions,” says Daniel Karlin, the chief medical officer of MindMed, a biotech firm.

What patients say they are feeling is also a possible source of confusion. Amit Etkin, the CEO of Alto Neuroscience, points out that in Asia the symptoms that Western psychiatry uses to diagnose depression—low mood, tearfulness and the like—do not work very well, because the symptoms are expressed in more physical terms: “I feel cold,’ ‘My limbs are heavy’, or abdominal distress”. But when depression is defined at a biological level, Dr Etkin says, the same distinct subtypes emerge—three to five of them, he reckons. Alto is trying to use EEGs and behavioural testing to match patients to drugs to improve the chances of giving patients the treatments that work best for them.

There are other arguments for taking issue with established diagnostic procedures. Take autism. A study published in 2021 found between 1998 and 2018 there had been a 787% increase in diagnosis in Britain. In America, it is now diagnosed in one in 44 children. Uta Frith, a professor emerita of cognitive development at University College London who worked on autism throughout that time, said this was evidence that the diagnosis had been “stretched to breaking point and has outgrown its purpose”.

The experiences of people affected by attention-deficit hyperactivity disorder (ADHD), depression, Parkinson's and other conditions also vary immensely. There is a growing awareness among those looking for therapies that better, more biological ways of defining patient populations are needed; better psychiatric treatments require clearer ideas about what needs fixing in whom. "I don't think in 20 years we will be calling things 'Alzheimer's,'" Kate Bingham, a managing partner at SV Health Investors, a venture-capital firm, predicts. "I think we will be talking about diseases driven by specific pathways and biologies."

The model here is oncology. Cancers used to be treated according to the organ in which they were found and their morphology. Today oncology is moving quickly towards molecular precision, identifying the specific pathway or pathways that are driving a cancer's growth and attacking them directly with a range of tools from small molecules to antibodies to genetically engineered immune cells. When Dr Etkin argues that the biology driving depression should be more "measurable, conserved and objective" he is speaking for a generation of researchers who want a similar level of insight into the mechanisms of the mind.

One advantage such measurements offer is the ability to "stratify" patients—that is, to split them into groups of patients who differ in some biologically relevant way. In September, scientists from Rensselaer Polytechnic Institute, in New York, proposed that the autism spectrum could be split into three distinct categories associated with different maternal risk factors such as infections, joint disorders and pregnancy complications. These sorts of findings allow distinct patient groups to be identified, making trials more likely to be clear cut.

Neumora, a remarkably well-funded startup based in Watertown, Massachusetts, puts "deconvolving" patient populations into more and more homogenous subtypes at the core of its work. As Paul Berns, head of

the firm and of ARCH, a venture-capital firm which is one of Neumora's investors, puts it, "We can't treat everybody the same way. We are getting really poor outcomes and spending a lot of money." The firm is making use of data on large cohorts of people, such as those collected by UK Biobank, which is following half a million people over decades, and the Parkinson's Progressive Markers Initiative funded by the Michael J. Fox Foundation. These cohorts show how diseases change over time at varying levels, from the genes on up.

One of Neumora's projects is a trial for a drug which blocks the kappa opioid receptor (KOR) in patients with severe depression. The trial is focused on patients with a high score for "anhedonia", the inability to feel pleasure. John Dunlop, Neumora's head of R&D, says data suggest that the KOR is expressed in areas of the brain that deal with motivation and reward. So if the drug works well in depressed patients with anhedonia it might be useful in other diseases where the deficit also crops up, such as schizophrenia and post-traumatic stress disorder. Similar approaches based on mechanism, rather than a classic diagnosis, have served oncology well, producing drugs such as PD-1- and PARP-inhibitors that cross organ-based cancer categories. Whether anhedonia cleaves closely enough to a detailed, and correctable, molecular mechanism in the brain will only become clear with further work.

| *Good for what ails you*

Other approaches look into the basic biology of the brain's development. In 2006 a technique was discovered whereby body cells could be turned into stem cells able to develop into a range of specialised cell types. With the right encouragement, and a three-dimensional scaffold on which to grow, neural stem cells made this way give rise to complex "organoids" made up of a range of different types of neuron and some glial cells, too. These "mini brains" composed of human cells have opened a whole new field of

research, making it possible to compare organoids from people who suffer from an affliction with those of people who do not. Organoids grown from cells from people with autism, for example, have more “inhibitory” neurons than is typical, which may make them prone to develop particular types of neural circuitry.

Another distinctively 21st-century approach is optogenetics. By adding genes for fluorescent proteins to an animal’s genome it is possible to see different pathways in the brain light up as they are activated. More remarkably, by adding novel genes which make proteins on cell surfaces light-sensitive, it is possible to create brains where the behaviour of specific types of neuron can be controlled from outside by light.

Lab animals grown with such modifications can show how, at a neurological level, they regulate complex behavioural states. Fluorescent markers reveal how neurons connect to each other, and allow a map of the brain’s highways and byways to be created—a “brainbow”. This has shown how patterns of neural activity regulate functions such as thirst, respiration, energy balance and sleep. It has revealed the dynamics of information transmissions and the patterns of activity that are involved in some of the brain’s plasticity.

Lab animals are not the only targets for genetic modification. Some patients undergo it too, in the form of gene therapies. In 2019, the gene-therapy drug Zolgensma was approved for use in patients with spinal muscular atrophy (SMA)—a progressive condition in which the loss of motor neurons weakens muscles. It is caused by mutations in the gene without which motor neurons find it hard to survive. Zolgensma delivers competent copies of the SMN1 gene to nerve cells inside a viral “vector”.

| *On your biomarkers*

Similar gene therapies are also a promising approach to various diseases of

the retina—the sheet of light-sensitive cells and neurons at the back of the eye—and to Dravet syndrome, a form of epilepsy. Lysosomal storage disorders, inherited metabolic diseases that are the source of many neurodevelopmental problems, also look like promising gene-therapy targets. But some diseases caused by an errant gene are proving challenging to address with this method. Efforts to tackle Huntington's, a fatal neurological disorder, with gene therapy have been fraught with difficulties.

Gene therapy is not the only approach to inherited disorders traced to a single gene. There are various cunning ways short pieces of DNA and its relative, RNA, can be used to change the amount of protein made according to the recipe in a particular gene, either reducing it or, sometimes, increasing it. Ionis Pharmaceuticals is working with Biogen to expand the use of some of these approaches in neurological diseases. It is testing a drug called tofersen to treat a form of ALS caused by a problem with the SOD1 gene—the defect behind the disease in 2% of patients. It is a good example of the benefits of stratification; if all forms of ALS were seen as the same, the potential of a drug that addresses a specific fraction of them would go unnoticed.

The tofersen trial is also a good example of the potential of biomarkers. A measurable biomarker that is well correlated to the course of disease gives researchers an early peek at whether success seems likely. The trial has seen “robust” reductions in the level of neurofilament (the structural components of the sheath that insulates nerve axons) in the blood. When neurons are injured, proteins from these structures are released into the blood. Their level is thought to indicate the numbers of damaged or degenerating nerves. In multiple sclerosis levels of neurofilament are lowered by treatment with a number of new disease-modifying therapies. The emergence of neurofilament, and other biomarkers, as trusted signs of the underlying course of a disease should facilitate a flurry of innovation.

The blood is not the only place to look for biomarkers. Imaging instruments and the precise study of bodily behaviour can also furnish them. But those found in the blood are particularly useful because of the ubiquity of blood testing. Biomarkers that truly track the course of a disease are not just useful for doctors and clinical trials. Some might also provide early warning of its development before the onset of symptoms—in time, perhaps, to make changes to the way in which they live.

| *TREMendous stuff*

The usefulness of such changes in patients' behaviour and situation is a reminder that, in most diseases of the brain, genes are only one factor, and a complicated one at that. The most common diseases of the brain are influenced by factors such as diet, exercise, the environment, life history and other diseases as well as by a set of genes the membership of which has risen rapidly as the sequencing of whole genomes has accelerated. There are now more than 100 genes associated with Alzheimer's, Parkinson's and ALS. Denali, a biotech company in San Francisco which is at the forefront of the field, calls genes involved in neurodegeneration "degenogenes", echoing the use of "oncogenes" in studies of cancer.

Identifying such genes is potentially helpful; it has also at times been misleading. Early genetic studies provided some evidence for a connection between Alzheimer's and beta amyloid which, in concert with the role of amyloid plaques in the disease, encouraged drugmakers down a blind alley. One school of thought is that genetic studies of people who have been diagnosed with a disease may be finding genes that have failed to protect their nerve cells from the progression of disease, rather than genes that identify the disease's causal mechanism.

In Alzheimer's, the broader range of associated genes now on offer may provide new clues. Sabah Oney, a venture partner with ARCH, says that if one looks at genes for the root cause of Alzheimer's it is startling that 22 of

the 25 highest-risk genes map directly to the immune system—and specifically to its inactivity. He likens the brain’s immune system to the fire brigade, police and rubbish collection. They all need to be continuously active to keep the brain healthy. If any fails, pathological damage accumulates.

One focus in the study of dementia is TREM2, a gene that codes for a protein on the surface of the microglia involved in the brain’s bit of the immune system. Alector, a biotech firm based in San Francisco, is one of the companies that think a drug aimed at that receptor protein might boost the microglia’s activity; it is developing an antibody drug to that end. Again, there is an analogy to oncology, where getting the immune system better engaged in the fight against disease is the focus of much research. Alector’s work has drawn the attention of GSK, a big pharma firm, which invested \$700m last year. Vigil Neuroscience, based in Massachusetts, is also targeting TREM2 as part of a strategy focused on microglia.

Investment in startups like Neumora, which explicitly brands itself a precision-neuroscience company, and gene-inspired pathway-specific approaches like those of Vigil and Alector, show that this approach is becoming popular with both researchers and investors. But not everyone is convinced. “Precision neurology is a bit of an oxymoron from a pharmacological perspective,” says Duncan Emerton of Citeline Pharma Intelligence, a data provider. “Current treatments for neurological indications are very rarely precise in their mechanism of action, with numerous off-target effects being seen.” It may come to be, but it is not here yet.

Jeff Jonas, chief innovation officer at Sage Therapeutics, a drug company, believes that so far the concept is incomplete. “The idea that you can find a single target that will give you an efficient pathway—it just has never been shown to be the case”. He likens the effort to precision elephant-

recognition, which provides good data on tails and trunks, but limited understanding of the animal. Sage's approach is to look for drugs active in the brain and seek out big effects. Its drug zuranolone, a neuroactive steroid, is related to a steroid already used to treat postpartum depression. Dr Jonas says it resets the brain's normal balance and, as a result, changes the end state of depression. The drug is intended to act quickly, far faster than traditional antidepressant drugs.

Whoever is right about the best approach to precision neuroscience, biomarkers and more tightly defined patient groups is certainly likely to yield stronger signals about the efficacy of trials—something that will improve the disastrous economics of the field. And in many ways, disagreement in the field about the right approach is to be welcomed. The failures of the past came from too much groupthink and a focus on the same narrow idea. A thousand flowers are blooming. Some of them will wither and die. But with so many new biotechs digging deep where big pharma has feared to tread, progress by some of them is inevitable. ■



精准神经医学

脑生物学进展将带来更好的药物

类器官和光遗传学提供的洞见很有帮助【专题《修复大脑》系列之一】

藏在颅骨内的脑损伤比一条折断的腿更难诊断。颅骨内有一个人会告诉医生自己的感觉，这似乎提供了解决办法。但患者自述的感受并不容易转化为一幅描绘大脑状况的图景。精神疾病的定义很模糊。“重度抑郁症和广泛性焦虑症在疾病定义上有80%的重叠。”生物技术公司MindMed的首席医疗官丹尼尔·卡林（Daniel Karlin）说。

患者自述的感受也可能造成困惑。Alto Neuroscience的首席执行官阿米特·埃特金（Amit Etkin）指出，西方精神病学用来诊断抑郁症的症状——情绪低落、流泪等——在亚洲的效果不太好，因为人们更多用身体上的感受来表达症状：“我感觉冷”，“我觉得四肢很沉”，或是肚子不舒服”。但埃特金博士说，当从生物学层面界定抑郁症时，就能得出同样的分类明确的子型——他估计有三到五种。Alto公司正在尝试用脑电图和行为测试来给患者匹配药物，以提高他们获得最适合自己的治疗的机会。

还有其他论据也对现有诊断程序提出了质疑。以自闭症为例。2021年发表的一项研究发现，1998年至2018年间，英国的确诊数字增加了787%。在美国，现在每44名儿童中就有一名被诊断为自闭症。伦敦大学学院（University College London）的认知发展学荣誉退休教授尤塔·弗里思（Uta Frith）在这段时期里一直研究自闭症。他说，这表明这项诊断已经“被用过头了，超出了自身目的”。

受注意力缺陷多动障碍（ADHD）、抑郁症、帕金森氏症和其他疾病影响的人的经历也千差万别。寻求治疗的人们越来越意识到需要更好、更从生物学出发的方法来界定患者群体，或者说，更好的精神疾病治疗需要更清楚地知道，要在谁身上修复什么。“我认为20年后我们不会再有‘阿尔茨海默病’这样的名称，”风投公司SV Health Investors的管理合伙人凯特·宾厄姆（Kate Bingham）预测，“我认为我们将讨论由特定路径和生物机制驱

动的疾病。”

这里的范本是肿瘤学。癌症过去是根据肿瘤所在的器官以及肿瘤的形态来治疗的。今天，肿瘤学正迅速朝着分子精度的方向发展，识别驱动肿瘤生长的某一个或多个路径，并使用从小分子到抗体、再到基因工程免疫细胞的各种工具直接抗击它们。当埃特金提出驱动抑郁症的生物机制应该变得更加“可测量、恒定和客观”时，他表达的是新一代研究人员的共同想法，他们希望对大脑机制的理解达到与肿瘤类似的水平。

这类测量方法带来的一个优势是能给患者“分层”，也就是把他们按某些生物学相关特征分组。9月，纽约州的伦斯勒理工学院（Rensselaer Polytechnic Institute）的科学家提出，自闭症可按孕产妇风险因素——感染、关节疾病和妊娠并发症等——划分为三个类别。这样的发现可以识别不同类型的患者群体，使临床试验更可能有明确的针对性。

位于马萨诸塞州沃特敦市（Watertown）的创业公司Neumora获得了非常丰厚的融资，其工作核心是把患者群体“反卷积”出越来越多的同质亚型。正如该公司负责人保罗·伯恩（Paul Berns，他也是公司的其中一个投资方ARCH风投公司的主管）所说，“我们不能用同样的方法治疗所有人。这得到的治疗结果很糟糕，却花费很多钱。”该公司正在利用包含大量人群的数据集，收集方有在几十年内跟踪了50万人的英国生物银行（UK Biobank），以及由迈克尔·J·福克斯基金会（Michael J. Fox Foundation）资助的帕金森氏进步标记计划（Parkinson's Progressive Markers Initiative）等。这些人群显示了随着时间推移，疾病如何在以基因为起点的不同层面发生变化。

Neumora的项目之一是测试一种可阻断严重抑郁症患者的κ阿片受体（KOR）的药物。测试对象是在“快感缺乏”（anhedonia，即无法感受到快乐）上得分高的患者。Neumora的研发主管约翰·邓洛普（John Dunlop）表示，数据表明KOR是在人脑内处理动机和奖励的区域里表达的。因此，如果这种药对患快感缺乏的抑郁症患者效果良好，那它可能也对其他同样出现这种症状的疾病有用，例如精神分裂症和创伤后应激障碍

（PTSD）。类似的基于机制而非经典诊断法的方法已经很好地服务于肿瘤学，带来了如PD-1和PARP抑制剂这样跨越了基于器官的癌症类别的药物。快感缺失是否密切相关到人脑中一个详细的、可纠正的分子机制则需要进一步研究才能明确。

| 直击你的烦恼根源

其他方法探究大脑发育的基本生物学。2006年发现的一种技术可将体细胞转化为能发育成一系列特殊细胞类型的干细胞。用这种方式制造的神经干细胞被放到一个三维支架上，加以恰当的刺激，生长出了包含一系列不同类型的神经元和一些神经胶质细胞的复杂的“类器官”。这些由人体细胞构成的“迷你大脑”开辟了一个全新的研究领域，可以把患有某种疾病的人的类器官与不患病的人的类器官放在一起对比。例如，从自闭症患者的细胞中生长而来的类器官比一般人具有更多的“抑制性”神经元，这可能使他们容易发展出某些特定类型的神经回路。

另一个也是本世纪才出现的方法是光遗传学。把荧光蛋白基因添加到动物的基因组中，可以看到它们脑中不同的通路在被激活时亮起。更值得注意的是，通过添加使细胞表面蛋白质对光敏感的新基因，就有可能创造出可用光从外部控制特定类型神经元行为的大脑。

利用在生长过程中接受过这种改造的实验室动物，可以展示这类改造如何在神经学层面调节复杂的行为状态。荧光标记揭示出神经元如何相互连接，绘制出一幅脑部干道和支路的地图——“脑虹”。这已展示出神经活动模式如何调节口渴、呼吸、能量平衡和睡眠等功能。它揭示了信息传输的动态以及与某些大脑可塑性相关的活动模式。

实验室动物不是基因改造的唯一对象。一些患者也以基因疗法的形式体验了它。2019年，基因治疗药物Zolgensma被批准用于脊髓性肌萎缩症（SMA）患者。SMA是一种运动神经元持续衰退而导致肌肉萎缩的进行性疾病，由基因突变引发——运动神经元在缺乏这种基因的情况下很难存活。Zolgensma把SMN1基因的正常功能副本传送到一个病毒“载体”内的神经细胞中。

| 关于你的生物标志物

类似的基因疗法为治疗各种视网膜疾病（视网膜即位于眼睛后部的一个感光细胞和神经元薄层）和Dravet综合征（Dravet syndrome，癫痫症的一种）带来了希望。溶酶体贮积症（LSD）是导致许多神经发育问题的遗传性代谢疾病，看起来也是很有前景的基因治疗目标。但一些由错误基因引致的疾病却似乎很难用这种方法来攻克。在把基因疗法用于亨廷顿舞蹈症这种致命的神经系统疾病时，研究人员遭遇了重重困难。

基因疗法并不是治疗由单一基因引发的遗传性疾病的唯一方法。有各种巧妙的方法，可以利用短片段DNA及其近亲RNA，来改变根据特定基因中的配方产生的蛋白质的数量——减少它，或者有时增加它。Ionis Pharmaceuticals正在与渤健（Biogen）合作以扩大其中一些方法在神经系统疾病中的应用。它正在测试用一种名为tofersen的药物来治疗由超氧化物歧化酶1（SOD1）基因突变引起的一类肌萎缩侧索硬化（ALS）——因这种缺陷致病的患者在ALS患者中占2%。从这个例子上可以明显看出“分层”的好处：如果所有类型的ALS被一视同仁，那么一种针对其中某个子集的药物潜力就会被忽视掉。

tofersen药物试验也是生物标志物潜力显现的一个好例子。一种与疾病进程密切相关的可测量生物标志物使研究人员能够及早窥见治疗是否可能取得成功。在tofersen的试验中已经能看到血液中的神经丝（包裹神经元轴突使之绝缘的髓鞘的结构成分）水平“稳健”降低。当神经元受伤时，这类结构中的蛋白质会释放到血液中，因此它们的数量水平被认为能够揭示受损或退化的神经的数量。在多发性硬化症中，运用一些新的疾病修正疗法（DMT）降低了神经丝的水平。神经丝及其他生物标志物成为揭示疾病潜在进程的可靠迹象，应该会促发一系列的创新。

血液并不是唯一可以寻找生物标志物的地方。成像仪器和对身体行为的精确研究也可以提供标志物。但血液检测无处不在，所以在血液中发现的标志物特别有用。真正能追踪疾病进程的生物标志物不仅对医生和临床试验有用处，有些还可能在症状出现之前就提供疾病发生的早期预警——也许就能及时改变患者的生活方式。

| 了不起的靶点

行为和生活状况的改变对这类患者有所裨益，这也提醒我们在大多数脑疾病中，基因只是致病因素中的一个——也是复杂的一个。最常见的脑疾病受饮食、运动、环境、经历和其他疾病等因素的影响，此外还受一组基因的影响，而随着全基因组测序速度加快，这些基因的成员数量也迅速增加。现在有超过100个基因与阿尔茨海默病、帕金森病及ALS相关。旧金山的生物技术公司Denali走在这个领域的前沿，它把参与神经退行性病变的基因称为“退化基因”，与癌症研究中所说的“癌基因”相对应。

找出这类基因可能会有帮助，但有时也会误导。早期的基因研究为阿尔茨海默病和 β 淀粉样蛋白间的联系提供了一些证据，加上淀粉样蛋白斑块在这种疾病中的作用，把制药商推进了死胡同。有一派观点认为，对被确诊某种疾病的人的基因研究可能会发现某些没能保护神经细胞避免生病的基因，而不是直接导致疾病的基因。

对阿尔茨海默病而言，目前已找到的更大数目的相关基因可能会提供新的线索。ARCH的风险投资合伙人萨巴赫·奥内（Sabah Oney）表示，如果看一看和阿尔茨海默病的根本病因相关的基因，你会吃惊的发现25个最高风险基因中有22个直接关联免疫系统，特别是免疫未激活。他将大脑的免疫系统比作消防队、警察和垃圾收集站。它们都需要持续保持活跃以维持大脑健康。如果有任何失职，病理性损伤就会累积。

痴呆症研究的一个重点是TREM2，这是一种编码小胶质细胞表面蛋白质的基因，而这种细胞与大脑的免疫系统有关。总部位于旧金山的生物技术公司Alector等一批公司认为，针对该受体蛋白的药物可能会增强小胶质细胞的活性。它正在为此开发一种抗体药物。这又让人想到了肿瘤学——让免疫系统更好地参与对抗疾病是许多肿瘤学研究的重点。Alector的研究引起了大型制药公司葛兰素史克（GSK）的注意，在去年获其投资7亿美元。总部位于马萨诸塞州的Vigil Neuroscience在其专注于小胶质细胞的方法中也把TREM2作为一个靶点。

像Neumora（一家明确自称精准神经学的公司）这样的创业公司以及Vigil

和Alector研究的那类疗法（受基因启发的路径特异性方法）所获的投资表明，精准神经医疗愈发受到研究人员和投资者欢迎。但并非所有人都信服。“从药理学的角度看，精准神经学有点自相矛盾，”数据供应商Citeline Pharma Intelligence的邓肯·埃梅尔东（Duncan Emerton）说，“目前对神经系统适应症的治疗在作用机制上鲜少是精准的，可以看到大量脱靶效应。”它可能会变得精准，但目前还没有。

制药公司Sage Therapeutics的首席创新官杰夫·乔纳斯（Jeff Jonas）认为，到目前为止，相关概念还不完整。“你以为可以找到单个靶点给你提供一条高效的路径——但事实证明从来都不是如此。”他把这种努力比作“精准摸象”，你拿到了关于大象的尾巴和象鼻子的好数据，但对这种动物仍然知之不多。Sage的方法是寻找在大脑中高度活跃的药物来产生大的效力。它的药物zuranolone是一种神经活性类固醇，与一种已经用于治疗产后抑郁的类固醇相关。乔纳斯博士说，它重置了大脑的正常平衡，从而改变了重度抑郁症状。该药物旨在快速起效，远远快过传统的抗抑郁药物。

无论谁采用的方法才是通向精准神经学的最佳途径，生物标志物和更严格定义的患者群体无疑很有希望生成关于试验疗效的更强信号——而这将改善这个领域灾难性的经济效益。从许多方面看，这个领域里围绕什么才是正确方法的争议很值得欢迎。过去的失败源于太多的群体思维以及大家钻在同一个狭隘想法里。而如今百花齐放。一些想法会枯萎凋零。但随着如此众多的新兴生物技术公司在大药厂一直不敢涉足的地带深入挖掘，其中一些势必会取得进展。■



More money, no problems

Dubai is the world's resurgent entrepot

An influx of Russians shows how the emirate gains by playing all sides

SUMMER IS SLEEPY in Dubai, a time when locals and rich expats flee for cooler climes. For the emirate's property brokers, though, this one was anything but languid. Viewings were a race: show up a few hours late and that sea-view apartment may already be spoken for. One spent whole afternoons camped out in the lobbies of fancy buildings, with showings every half-hour. The United Arab Emirates (UAE), a seven-member federation that includes Dubai, is forecast to add 4,000 new millionaire residents this year, more than any other country. That is welcome news for a property market which contributes 8% of GDP—if not for brokers who want to be on a beach.

These are heady times for the Middle East's energy exporters. The Saudi economy is projected to grow by 7.6%, among the world's fastest rates. Smaller Gulf states will have windfalls to pay down debt and top up sovereign-wealth funds. Even dysfunctional countries like Iraq should run surpluses. But the UAE, and Dubai in particular, does not only benefit from high energy prices. It also gains from the sanctions and geopolitical disruptions that helped send those prices soaring. The city's stockmarket has risen by 9% this year, compared with a 2% lift in Riyadh.

Even before Russia invaded Ukraine, Dubai was in a stronger position to grow as a financial hub with giant, established rivals struggling. Hong Kong grows less attractive as it falls further into China's orbit. It has also suffered from covid-19 restrictions. Meanwhile, London has lost some of its shine since Brexit—and no longer welcomes Russian capital. Dubai is the last financial hub where just about anyone can do business with just about anyone else.

This is most obviously visible in the city's property market. Russians bought more than twice as many homes in Dubai in the first half of 2022 as they did in the whole of last year. Betterhomes, a property firm, says they were the fourth-largest group of buyers, up from ninth place in 2021. Banking restrictions are no obstacle: one real-estate broker is said to have installed an ATM in its office to facilitate cash transactions. Scores of Russian yachts are anchored in Emirati marinas, while oligarchs' private jets loiter at a previously little-used airport south of Dubai.

Firms, both local and multinational, are shifting their operations. Banks like Goldman Sachs and Bank of America have moved employees from Moscow to Dubai. Commodity firms are considering a move from Switzerland, which has joined EU sanctions on Russia. In Fujairah, on the east coast of the UAE, local companies are piling into the arbitrage business. They can buy Russian oil at a steep discount, refine it, then sell the finished products at market-price. All of this is made possible by the UAE's neutral stance on the war. Although a longtime Western ally, it has declined to join Western-led sanctions on Russia.

Dubai is not the only bolthole available. Some Russians have decamped to Turkey; the country's attractiveness is limited, however, by a crashing currency and surging inflation. The UAE offers no such worries. Its currency, the dirham, is pegged to the dollar and has not budged since 1997. Public debt is a manageable 32% of GDP; inflation is expected to peak at less than 4%. The banking system is trustworthy and well-capitalised. The income-tax rate is a hard-to-beat 0%. Scorching weather might be a shock, but Dubai offers all the amenities Russian émigrés would expect: designer brands in malls, renowned chefs in hotels, luxury homes with domestic help. Diners at a new restaurant in the financial district can order a baked potato stuffed with caviar for a mere 2,610 dirhams (\$710).

These attractions have already lured business from elsewhere. Dubai has

made itself a financial hub that serves not just the Middle East but Asian and African markets. Indian businessmen, for example, find much to like. They enjoy tax breaks and better schools and hospitals. Lawyers can fly over in just three hours for international deals, a much shorter trip than to London or Singapore. Sovereign-wealth funds are a big source of cash for private-equity and venture-capital firms. One Indian bigwig says that half his friends in south Mumbai have bought flats in Dubai.

Along with licit business there is the dodgier sort, too, from Irish mobsters to Iranian traders looking to circumvent sanctions. Establishments that cater to the rich, like a penthouse lounge on an artificial island in the Gulf, can have a bar-scene-from-Star-Wars vibe, albeit with \$100 Wagyu steaks, \$1,600 bottles of Cristal and less jaunty music. The illicit gold trade alone was once estimated to be worth around \$4bn a year (though the government has taken some steps to clean it up).

| *Double-edged sword*

Dubai's freewheeling political economy can cause tension. For much of the past decade it was Abu Dhabi, the UAE's less commercial capital, which set the tone on foreign policy. The Arab spring of 2010-11, and the chaos it unleashed, put the country on a war footing. The UAE joined the Saudi-led invasion of Yemen in 2015, and sent arms to an aspiring dictator in Libya. It also pushed for the embargo of Qatar in 2017, which saw four Arab states cut trade and travel ties with the irksome emirate.

Some of this was bad for business. Qataris used to buy lots of property in Dubai, either as an investment or as a second home in a more libertine city. The blockade cut them out of the property market. Earlier this year the Houthis in Yemen launched several rounds of missiles and drones at Abu Dhabi, a worrying event in a country that depends on a reputation for stability.

Since 2019, though, the UAE has swung back towards the Dubai model. It withdrew troops from Yemen that summer and has cut its role in Libya. The blockade ended last year. This was pragmatism: neither war nor the blockade brought the hoped-for benefits. Thus hard-nosed foreign policy is out and economic diplomacy is in.

Take the sanctions-busting oil trade in Fujairah. Before they started importing Russian crude, firms there helped Iran sell its own oil. The commercial motive was straightforward: arbitrage is easy money. From the government's perspective, the trade also served a political purpose. The UAE was unnerved by an Iranian-sponsored attack in 2019 on Saudi oil facilities, which briefly shut down half the kingdom's output. Acting as a middleman makes the UAE useful to Iran, and perhaps reduces the risk of a similar attack.

In March the Financial Action Task Force, the world's main anti-money-laundering body, put the UAE on its "grey list" of problem countries. The listing has no formal consequences, and bankers say it has not changed the UAE's reputation: anyone doing business there is already aware of the risks. But Emirati officials were upset by their inclusion (and hope to be removed from the list by the end of 2023).

Financial institutions are investigating their newest clients. The government has told them not to deal with Russians who are under Western sanctions. "Banks want to future-proof their compliance," says one Dubai-based financial analyst. But there are still choices to be made. A Russian with \$1m in assets is probably not worth the headache. One with \$10m? Maybe.

A more serious worry is running afoul of American sanctions, which would be dreadful for a country with a big financial sector and dollar-linked currency. Yet America does not seem to want to look closely at the UAE.

Every few months a group from the Treasury department flies out to chide the Emiratis. In June Wally Adeyemo, the deputy secretary, told bankers to be careful with Russian customers. Aside from a few token sanctions on small firms—mostly for dealings with Iran—America has done little more than talk, however. The UAE has convinced many Americans that it is an indispensable partner in the region. Forging diplomatic ties with Israel in 2020 was a masterstroke.

This leaves Dubai in an enviable position. Whether or not America and Iran reach a nuclear deal, it can serve as an economic lifeline for Iran, as it has for years. However the war in Ukraine progresses, it can now play much the same role for Russia. Sitting on the sidelines is making Dubai the world's resurgent entrepot. ■



钱多了，问题没了

迪拜，复兴的全球转口中心

从大量俄罗斯人涌入看这个酋长国如何凭八面玲珑获益

迪拜的夏天冷冷清清，当地人和富有的外籍人士纷纷逃往凉爽的地区避暑。然而对于迪拜的房地产中介来说，这个夏天可一点都不清闲。带人看房简直就像比赛，迟到几个小时，那栋海景公寓可能就已经花落别家。中介一整个下午就待在几个豪华建筑的大堂里，每半小时就有人来看房。由包括迪拜在内的七个酋长国组成的阿联酋预计今年将新增4000名百万富翁级居民，比其他任何国家都多。这对在GDP中占8%的房地产市场来说是个好消息，虽说对也想去海边度个假的中介来说不一定。

中东的能源出口国正在经历一段令人陶醉的时光。预计沙特经济将增长7.6%，是全球增长最快的国家之一。小一点的海湾国家也会发些横财，可以用来偿还债务及补充主权财富基金。即使像伊拉克这样局势混乱的国家也应该会出现盈余。但让阿联酋——尤其是迪拜——受益的不仅是高企的能源价格，还有推动了能源价格飙升的制裁和地缘政治动荡。迪拜的股市今年上涨了9%，相比之下，利雅得上涨了2%。

即使在俄罗斯入侵乌克兰之前，迪拜就已趁着那些强大的老牌竞争对手陷入挣扎之时，占据了扩张金融中心的更有利位置。随着中国收紧对香港的控制，这座城市的吸引力越来越小，而且还深受新冠防控政策的影响。与此同时，自英国脱欧以来，伦敦已经失去了一些光彩，而且不再欢迎俄罗斯资本。迪拜是最后一个几乎谁跟谁都能做交易的金融中心。

这一点在迪拜的房地产市场上最为明显。2022年上半年，俄罗斯人在迪拜购买房屋的数量是去年全年的两倍多。房地产公司Betterhomes表示俄罗斯人是第四大买家群体，他们在2021年还排名第九。银行限制对他们来说不是障碍。据说为了方便现金交易，一个房地产经纪公司在办公室安装了一台自动取款机。许多俄罗斯游艇停泊在阿联酋的码头，寡头们的私人飞机则停放在迪拜南部一个以前很少使用的机场。

本地和跨国公司都在调整运营。高盛和美国银行（BOA）等银行已将员工从莫斯科调到迪拜。大宗商品公司正在考虑从已加入欧盟对俄制裁的瑞士撤出。在阿联酋东海岸的富查伊拉（Fujairah），当地公司正涌向套利生意。它们可以按极低的折扣价购买俄罗斯石油，精炼之后以市场价格出售成品油。阿联酋在俄乌战争中的中立立场让这一切都成为可能。虽然长久以来阿联酋都是西方的盟友，但它拒绝加入西方主导的对俄制裁。

迪拜并不是唯一的避难所。一些俄罗斯人逃去了土耳其，但由于货币暴跌，通胀飙升，该国的吸引力有限。在阿联酋没有这样的担忧，其货币迪拉姆与美元挂钩，自1997年以来汇率一直很稳定。公共债务占GDP的32%，水平可控。预计通胀峰值将在4%以下。银行系统值得信赖且资本充足。所得税率为零，罕有匹敌。炎热的天气可能会让人一时难以适应，但迪拜有俄罗斯移民想要的一切享乐设施——商场里的设计师品牌店、酒店里的名厨，以及有家政打理的豪宅。在金融区一家新开的餐厅里，一个填了鱼子酱的烤土豆才要2610迪拉姆（710美元）。

这些诱人之处已经从其他国家招来了生意。迪拜打造的金融中心不仅服务中东，还服务亚洲和非洲市场。比如印度商人就很喜欢迪拜，他们在这里可以享受税收减免，学校和医院也都更好。律师在短短三个小时内就可以飞过来处理国际交易，比去伦敦或新加坡要近得多。主权财富基金是私募股权和风投公司的重要现金来源。一位印度大佬说，他在孟买南部的朋友有一半都在迪拜买了公寓。

除了合法业务之外，迪拜也经手经不起细究的生意，涉及从爱尔兰黑帮到希望规避制裁的伊朗商贸公司。迪拜有大量服务富人的场所，比如波斯湾沿岸人工岛上的天际酒廊。这些地方的装修可能是星球大战风，不过一份和牛牛排要100美元，一瓶Cristal香槟1600美元，音乐也没那么活泼轻快。曾有估计称这里仅非法黄金交易就价值每年约40亿美元（不过政府已经采取了一些整顿措施）。

| 双刃剑

迪拜宽松放任的政治经济可能会导致紧张局面。在过去十年的大部分时间

里，给阿联酋的外交政策确定基调的都是不及迪拜商业化的首都阿布扎比。2010年至2011年的阿拉伯之春及其引发的混乱让该国处于备战状态。阿联酋于2015年参与了沙特领导的入侵也门的行动，并向利比亚一个野心勃勃的独裁者提供武器。它还在2017年推动了对卡塔尔的禁运，让四个阿拉伯国家与这个烦人的酋长国切断了贸易和旅行往来。

其中一些行动损害了商业。卡塔尔人曾在迪拜购置大量房产，要么作为投资，要么是在一个更自由放纵的城市里安第二个家。禁运把他们排除在了迪拜的房地产市场之外。今年早些时候，也门的胡塞武装向阿布扎比发起了几轮导弹和无人机袭击，这在一个以稳定知名并借此发展的国家是个令人担忧的事件。

不过，自2019年以来，阿联酋已转向迪拜模式。那年夏天它从也门撤军，同时也已减少对利比亚的干预。禁运于去年结束。这都是务实的行动，毕竟战争和禁运都没有带来预期的好处。因此，强硬的外交政策已经结束，取而代之的是经济外交。

以富查伊拉违反制裁的石油贸易为例。那里的公司在开始进口俄罗斯原油之前，曾帮助伊朗出售石油。其中的商业动机直截了当——套利好挣钱。从政府的角度来看，这些贸易也能服务于政治目的。2019年，沙特的石油设施遭到了背后有伊朗支持的袭击，一度令沙特的石油产量减半，这令阿联酋深感不安。扮演中间人的角色让阿联酋对伊朗有用处，或许能降低遭到类似袭击的风险。

3月，世界主要反洗钱机构金融行动特别工作组（Financial Action Task Force）将阿联酋列入问题国家“灰名单”。上名单没有任何正式后果，银行业人士表示这并没有影响阿联酋的声誉，因为在那里做生意的人本来就知道存在风险。但阿联酋官员因为本国上了灰名单而感到不快（并希望能在2023年底之前下榜）。

金融机构正在调查它们最新的客户。政府告诉它们不要和受到西方制裁的俄罗斯人打交道。“银行希望未来不会有合规问题。”迪拜的一名金融分析

师表示。但还是会面对选择。身家100万美元的俄罗斯人可能不值得费那个劲，但如果是1000万美元呢？那就不好说了。

阿联酋更担心的是和美国的制裁产生冲突，这对于一个拥有庞大的金融部门以及货币与美元挂钩的国家来说可不是好事。不过美国似乎没打算太关注阿联酋。每隔几个月，美国财政部就会有一批官员飞过去敲打一下阿联酋人。6月，副部长沃利·阿德耶莫（Wally Adeyemo）告诉银行家跟俄罗斯客户打交道要小心。然而，除了对一些公司实施了象征性的制裁（主要因为和伊朗做生意）之外，美国基本上都还是嘴上说说而已。阿联酋已经让许多美国人相信它是美国在该地区不可或缺的合作伙伴。它在2020年与以色列建立外交关系是一记高招。

这让迪拜的处境令人羡慕。无论美国和伊朗是否能达成核协议，它都可以继续像以往多年来那样充当伊朗的经济命脉。现在它还可以为俄罗斯扮演几乎相同的角色，无论乌克兰战局如何发展。置身事外正让迪拜重新崛起为全球转口中心。 ■



Iron Man with a dodgy peace plan

How worried should you be about Elon Musk's superpowers?

With great technological power comes great political responsibility

AS THE BOSS of Tesla, the world's most valuable carmaker, and SpaceX, the world's second-most valuable unicorn, Elon Musk is the stuff of business legend. As a gifted technologist with an enduring air of misfit adolescence he also has more than a whiff of the comic book about him. When he is talked about as an inspiration for Tony Stark in the "Iron Man" and "Avengers" movies, it is not just because he too is a fabulously rich, frequently irritating egotist with a saviour complex. It is because he has every intention of using the remarkable technological capabilities under his control to change the future course of history.

Mr Stark wanted to put a suit of artificially intelligent armour around the world. Mr Musk wants to help stabilise its climate (hence his focus on electric cars) and to establish an outpost of civilisation on Mars (hence the rockets, one of which sent four astronauts to the International Space Station on October 5th). To help fund the Mars effort, SpaceX launched Starlink, a huge constellation of satellites that provide internet access to isolated users. Meanwhile, Mr Musk said on October 3rd that he would, after all, buy Twitter, a social-media platform—a move he portrays as a civilisation-preserving defence of free speech.

Given Mr Musk's desire to change the future, it is hardly surprising to see him using the powers he is accruing to intervene in the present, too. After the invasion of Ukraine, SpaceX sent Starlink terminals and switched on satellite coverage. Ukraine has been vocal in its gratitude for this intervention, which helped its cities restore vital services and its forces prevail on the battlefield. But it was less thrilled when Mr Musk took to Twitter last week to suggest a "peace plan" that would give Crimea to

Russia, and possibly other occupied territories, too. Volodymyr Zelensky, Ukraine's president, asked his own 6.7m followers whether they preferred a pro-Ukraine Mr Musk or a pro-Russia one—a reminder, if one were needed, of Twitter's influence in shaping global perceptions of the war.

The fact that Mr Musk can, in a single week, get into a Twitter spat with the president of Ukraine, in an online discussion forum that he has just agreed to buy, while also sending people into orbit, demonstrates the extent to which his growing technological superpowers have granted him geopolitical clout. Should that be cause for admiration or concern?

In themselves, Mr Musk's political musings on Twitter matter little. But given the platform's important role in the febrile world of politics, his decisions about Twitter itself (such as whether to reinstate Donald Trump's access), will matter a lot more. So will decisions about Starlink. Whatever your politics, it is worrying that one man can choose whether to extend internet access to anywhere on Earth, can decide who can use it—and can turn it off at will.

There is no commercial case against Mr Musk's accumulation of power. Starlink is not a monopoly; nor is SpaceX's satellite-launch business (though it is currently the West's only option for launching astronauts into orbit); nor is Twitter. But all three have global importance, and will do for some time to come.

Mr Stark's attempt to put armour round the Earth led to its near destruction; the chastened billionaire subsequently accepted UN oversight. Mr Musk seems unlikely to follow suit. Comic-book fans must hope instead that he takes to heart the wisdom imparted to Peter Parker, aka Spider-Man: "With great power comes great responsibility." As Robert Caro observed in response to Lord Acton's famous dictum, power may not always corrupt, but it always reveals. What Mr Musk's power reveals will bear close

inspection. ■



【首文】钢铁侠提出不可靠和平计划

要多警惕马斯克的超能力？

技术能力越大，政治责任越大

作为全球市值最高车厂特斯拉及世界第二大独角兽SpaceX的老板，马斯克是个商业传奇人物。他是个技术天才，身上一股叛逆少年的桀骜气息从未褪去，而且还带着浓重的漫画人物的味道。有人说他是电影《钢铁侠》和《复仇者联盟》中托尼·史塔克（Tony Stark）的原型，不仅仅因为他跟史塔克一样富甲天下、自大狂的做派常惹恼人、有救世主情结，还因为他们都热切希望运用自己手中非凡的技术力量来改变未来历史的进程。

史塔克想给世界套上一副人工智能的盔甲。马斯克希望帮助稳定气候（因此专注于电动汽车）并在火星上建立人类文明的前哨站（于是有了火箭项目，其中一枚火箭在10月5日把四名宇航员送上了国际空间站）。为募集资金推进火星移民，SpaceX推出了星链（Starlink），发射大批卫星，为偏远地区的用户提供互联网接入服务。与此同时，他在10月3日表示，他还是会收购社交媒体平台推特，他称这是为了捍卫言论自由，事关文明存续。

鉴于马斯克有强烈的意愿改变未来，他会利用自己逐渐积累的力量来同样干预“现在”也就不足为奇了。在乌克兰被入侵后，SpaceX向当地运送星链终端机并开启了卫星覆盖。乌克兰对这种干预大表感激，因为这帮助城市恢复了关键服务，也帮助乌军在战场取得上风。但上周马斯克在推特上提出一项“和平计划”，提议将克里米亚（或许还有其他俄占区）并入俄罗斯。这就让乌克兰不那么高兴了。总统泽连斯基发推问自己的670万粉丝是更喜欢亲乌克兰的马斯克还是亲俄罗斯的马斯克，这也提醒人们（如果还需要提醒的话）推特在左右全球对这场战争的看法上具备的影响力。

在同一周内，马斯克能在他刚同意收购的线上论坛上和乌克兰总统打嘴仗，还能发射载人飞船把宇航员送入轨道，表明他与日俱增的技术超能力已赋予他在地缘政治上的影响力。对此，人们该钦佩还是担忧呢？

马斯克发在推特上的政治思考本身无关紧要，但鉴于该平台在狂热的政治世界中所扮演的重要角色，他关于推特本身的决策将事关重大得多，例如是否恢复特朗普的推特账户。他对星链的决策也是如此。单凭一个人就可以随心所欲地决定是否把互联网接入延伸到地球上任一角落，说给谁用就给谁用，想切断就切断，无论何种政治立场的人都会为此担忧。

从商业角度看，马斯克积聚影响力无可厚非。星链并没有构成垄断，SpaceX的卫星发射业务也没有（尽管目前它是西方运送宇航员进入太空轨道的唯一选择），推特同样没有。但三者在全球都举足轻重，而且在未来一段时间内都将如此。

史塔克想给地球穿上盔甲，几乎导致地球毁灭。这位受到教训的亿万富翁后来接受了联合国的监督。马斯克似乎不太可能这样。漫画迷们只能寄望他能记住蜘蛛侠彼得·帕克（Peter Parker）被传授的智慧：“能力越大，责任越大。”正如罗伯特·卡罗（Robert Caro）对阿克顿勋爵（Lord Acton）那句名言提出的不同见解，权力未必总致人腐败，但总会暴露人的真面目。马斯克的权力会暴露什么值得仔细观察。■



Free exchange

China's rulers seem resigned to a slowing economy

Gone are the days when they led the world in recession-busting

IN 2011 THE American Economic Review published an influential article entitled “Growing like China”. Its authors, including Zheng Song of the Chinese University of Hong Kong, tried to explain the country’s distinctive pace and pattern of development. The title was as well received as the argument, echoed in a variety of papers such as “Innovating like China”, “Investing like China” and “Internationalising like China”.

This year, however, the country is not growing like China at all. Thanks to its deep property slump and the government’s “zero-covid” policy, which entails lockdowns in response to every outbreak of the virus, the economy is now forecast to grow by less than 3% in 2022, according to banks such as Nomura, Morgan Stanley and UBS. That is far below the official target of 5.5%.

China’s currency is also weakening. On September 16th it took more than seven yuan to buy a dollar for the first time since July 2020. A gap has opened up between the GDP path envisaged for China at the start of this year and the grimmer one that now seems probable. China’s GDP in 2023 could be more than \$2trn below the level forecast in January, reckons Goldman Sachs, another bank.

It is not like China to settle for such underperformance. In the past, economists have marvelled at its ability to stimulate spending when necessary, so as to meet its growth targets and adequately employ its busy workforce and workshops. Even after the global financial crisis in 2008, China’s GDP quickly caught up to where it would have been had the crisis never happened. Impressed by this result, Yi Wen of the Federal Reserve

Bank of St Louis and Jing Wu of Tsinghua University wrote another “like China” paper, entitled “Withstanding the Great Recession like China”.

The country’s resilience, the authors argued, rested on the unconventional bust-busting tools that it had at its disposal. China, like other countries, eased monetary policy when the global financial crisis struck. But in other countries, companies and consumers remained reluctant to borrow even at rock-bottom interest rates. As a result, monetary easing did not translate into a big expansion of credit. In China, by contrast, state-owned enterprises and local-government financing vehicles (which invest in infrastructure and other civic projects) borrowed eagerly from China’s banks at the government’s behest. Other countries pushed on a string. China had other strings to pull.

Why, then, is China not withstanding this year’s slowdown as it did in the past? Its fiscal deficit, broadly defined to include off-budget borrowing, will increase this year. But only by about 3% of GDP, according to Goldman Sachs. The fiscal swing was more like 4% of GDP in the two years from 2008 to 2010. And it was even larger in response to China’s property slowdown in 2015. Tax breaks for firms account for a big share of this year’s stimulus, compared with the negligible role they played in 2008-09. That could be more efficient, if companies know better than the government how to spend the money. But it may be less effective, if firms choose not to spend it at all.

Local governments and their financing vehicles, which led the stimulus efforts in 2008, are not now so bold. The property slump has hurt land sales, which accounted for about a third of their revenues last year. And the signs of financial strain are not confined to the ledger books. To plug budgetary holes, 80 out of 111 cities tracked by Southern Weekly, a mainland newspaper, increased the amount they collected in fines last year. Yulin, a city in Shaanxi province, imposed a fine of 66,000 yuan (\$9,500) on a

grocer for selling 2.5kg of subpar celery. An indebted state-owned bus company in Lanzhou, the capital of Gansu province, floated an ingenious idea to pay the overdue salaries of some of its staff. Unable to apply for additional loans itself, it suggested the employees themselves take out loans, which the company pledged to repay.

The lack of avid borrowers is blunting China's monetary policy, much as it did in other big economies after the global financial crisis. China has cut a variety of interest rates, including its first reduction in the benchmark deposit rate since 2015. Yet faster growth in the money supply has not so far translated into an equivalent acceleration of credit.

In principle, the central government could do more itself to revive growth. It could increase spending or help bridge the financial gaps suffered by lower levels of government. It has allowed local authorities to issue another 500bn yuan of "special bonds" (which are supposed to be repaid with revenues from the infrastructure projects they finance). But that is both less than many analysts expected and less than required.

China's leaders may be seeking to avoid the past's mistakes, even if it means also forgoing the past's successes. Xi Jinping, China's president, and Li Keqiang, its prime minister, came into office in 2013, several years after the financial crash, when the unwelcome after-effects of China's stimulus efforts were keenly felt. Torrential spending by the many arms of the state left behind excess capacity, a skewed pattern of production and heavy debts. Mr Li has repeatedly promised not to resort to "flood-like" stimulus, a veiled reference to the past.

| *From hero to zero*

There is a simpler explanation for the change of approach, too. Mr Xi has become deeply invested in maintaining a "zero-covid" regime, which he portrays as proof of China's superior social model. Local governments are

under pressure to keep a lid on infections; a preoccupation that would distract them from an all-out effort to boost public investment, even if the financing were available. In addition, the ever-present threat of lockdowns has crushed the confidence of consumers and entrepreneurs. Thus any additional government outlays would be less effective in stimulating private spending. Other countries may outpace the country's economy this year. But no one fights covid-19 like China. ■



自由交流

中国领导人似乎已对经济放缓听之任之

他们不再领跑全球抗衰退

《美国经济评论》（American Economic Review）在2011年发表了一篇颇具影响力的文章，题为《中国式增长》。文章的作者（香港中文大学的宋铮是作者之一）试图解释中国独特的发展步伐和模式。文章的观点受到好评，其标题也为一系列文章效仿，如《中国式创新》、《中国式投资》和《中国式国际化》。

然而，今年中国的增长却全然不是中国式的。由于房地产严重滑坡和政府的“清零”政策（每次出现新冠疫情都实施封锁），野村证券、摩根士丹利和瑞银等投行的数据显示，目前预计2022年中国经济增速将不到3%。这远远低于5.5%的官方目标。

人民币也在走弱。9月16日，人民币兑美元汇率自2020年7月以来首次破七。相比今年年初时对GDP的展望，目前来看可能的走势更加黯淡。另一家投行高盛估计，中国2023年的GDP可能比今年1月时预测的水平低2万亿美元以上。

安于这种表现欠佳可不像中国的作风。过去，经济学家惊叹中国总能在必要时刺激支出，从而实现增长目标，并充分有效地部署它繁忙的劳动力和生产车间。即使在2008年全球金融危机之后，中国的GDP也迅速摆脱了危机影响，重回正常走势。圣路易斯联储的文一和清华大学的吴璟对这一成就印象深刻，撰写了又一篇“中国式”论文，题为《中国式抵御大萧条》（Withstanding the Great Recession like China）。

两位作者认为，中国的韧性缘于它有非常规的抗萧条工具可供调遣。与其他国家一样，中国在全球金融危机爆发时也实施了宽松的货币政策。但在其他国家，即使利率已降到最低，企业和消费者仍然不愿借贷。结果，货币宽松并没有转化为大规模的信贷扩张。相比之下，中国的国有企业和地

方政府融资平台（投资于基础设施和其他市政项目）按政府的指示积极地向中国的银行借款。其他国家的货币措施实则已经使不上劲，中国却可以运用其他隐性力量操纵推动。

那么，为何今年中国没有像过去那样抵御经济放缓？包括预算外借贷的广义财政赤字今年会增加。但高盛的数据显示，增幅只相当于GDP的3%左右。在2008到2010年的两年期间，财政扩张的幅度差不多是GDP的4%。而在2015年，为应对房地产市场放缓，财政扩张的幅度还要更大。今年的刺激措施中很大一部分是对企业的税收减免，而在2008至2009年间减税扮演的角色微不足道。如果企业比政府更能够善用这笔钱，那么采用这种方法就可能更高效。但如果企业选择根本不花这些钱，那效果就会更差。

地方政府及其融资平台在2008年的刺激措施中发挥了带头作用，现在却不再那么勇往直前。房地产低迷重挫了卖地收入，这部分去年约占它们总收入的三分之一。财政紧张迹象不仅体现在账簿上。为了填补预算缺口，在国内报纸《南方周末》追踪的111个城市中有80个城市去年增加了罚没收入。陕西省榆林市对一家出售了5斤劣质芹菜的杂货店处以6.6万元罚款。在甘肃兰州，一家负债累累的国有公交公司提出了一个妙招来解决拖欠部分员工工资的问题。由于公司自身已无法再申请更多贷款，它建议员工们自己去贷款，公司承诺偿还。

缺乏借款积极性削弱了中国货币政策的作用，很像全球金融危机后在其他大型经济体发生的情况。中国已经下调了多种利率，包括自2015年以来首次下调基准存款利率。然而到目前为止，货币供应的加速增长并未转化为同等的信贷扩张。

原则上，中央政府本身还有更多手段来提振增长。它可以增加支出，或者帮助下级政府填补财政缺口。中央已经允许地方政府再发行5000亿元的“专项债”（据信将用地方政府出资建设基建项目的收入来偿还）。但这一额度低于许多分析师的预期，也低于实际需求。

中国领导人或许是不想重蹈覆辙，哪怕这也意味着放弃过去那种成功。中

国国家主席习近平和总理李克强于2013年上任时，金融危机已经过去了几年，而刺激措施留下的不利后遗症此时却带来了切肤之痛。政府多个部门的猛烈支出留下了过剩的产能、扭曲的生产模式以及沉重的债务。李曾反复承诺不搞“大水漫灌”（对过去刺激措施的含蓄提法）。

| 英雄清零

这种做法的转变还有一个更简单的解释。习已经下重本维持“清零”制度，将之塑造为中国社会模式优越性的证明。地方政府承受着遏制新冠病例的压力，即使有资金，对防疫的高度重视也会导致它们无暇全力推进公共投资。此外，随时可能实施的封锁也粉碎了消费者和企业家的信心。因此无论政府如何增加支出，刺激私营部门和个人支出的效果也会打折扣。其他国家今年的经济增速可能超过中国。但中国式抗疫仍然无人能及。■



Chain reaction

Vietnam is emerging as a winner from the era of deglobalisation

Yet achieving its goal of becoming a rich country by 2045 will still be a huge task

ANTONY TO swaggers between the rows of humming machines in his factory in Bac Ninh province, in Vietnam's north-east, as they spit out blistering-hot bits of plastic. His firm, Hanpo Vina, ships the bits to the Samsung plant down the road as well as to nearby makers of printers, speakers, laptops and other electronic items. Mr To picks a Brazil-bound Samsung phone charger from a counter and displays it proudly. On the back, laser-etched in Portuguese, is a version of that familiar stamp of globalisation: Fabricado no Vietnam.

That message—Made in Vietnam—has been emblazoned on ever more products in umpteen languages since the formerly communist economy started opening up and promoting private enterprise in the late 1980s. Since 2000, Vietnam's GDP has grown faster than that of any Asian country bar China, averaging 6.2% per year. It has lured big foreign firms in droves. What started with apparel makers such as Nike and Adidas seeking low-skilled labour has turned into a boom in electronics—higher-value goods that create better-paid jobs for more highly skilled workers. In 2020 electronics made up 38% of Vietnam's goods exports, up from 14% of a much smaller pie in 2010 (see chart).

The trade war between America and China, which started in 2018, has helped. In 2019 Vietnam produced nearly half of the \$31bn-worth of American imports that moved from China to other low-cost Asian countries (though some of these goods were probably just modified Chinese-made ones stamped "Made in Vietnam").

Add to that growing geopolitical tensions between the superpowers,

China's onerous pandemic restrictions and its rising labour costs, and it is easy to see why many big firms are turning to Vietnam. Apple's biggest suppliers, Foxconn and Pegatron, which make Apple Watches, MacBooks and other gadgets, are building big factories in Vietnam and look set to join the ranks of the country's largest employers. Other big names moving chunks of production from China to Vietnam include Dell and HP (laptops), Google (phones) and Microsoft (game consoles).

All of which could lead to more growth, and make millions of Vietnamese people better off. That in turn could boost the popularity of the Communist Party, which has run the country as a one-party state since the end of the war in 1975. The government wants Vietnam to become rich—with GDP per person exceeding \$18,000, up from just \$2,800 today—by 2045. It hopes to do this partly by moving from cheap garments to complex electronics that require investment and skilled labour.

Vietnam has many things working in its favour. Its workforce will remain young and sprightly as China's ages and shrinks. The country is an enthusiastic member of over a dozen free-trade agreements, giving it easier access to scores of national markets. Its political leaders are less skittish about covid-19 than China's, too. Vietnam fully reopened its borders in March. China retains many barriers to entry.

The country of some 100m people also has geographical blessings, such as more than 3,000km of coastline. And it is right on China's doorstep. Thanks to massive infrastructure spending on things like new roads, its electronics cluster is just a 12-hour drive from Shenzhen, China's tech capital. "You don't have to reinvent your supply chains here," says one industrial-park operator. The government's knack for staying cosy with both China and America is valuable, too.

Yet there is still plenty to be done if Vietnam's factories are to move farther

up the value chain. Its manufacturing base is still much shallower than China's. Foreign firms would love to buy more parts locally, which could be faster and more convenient than sourcing them from just over the border. But they usually fail to find what they seek.

The Hanpo Vina factory of which Mr To is justly proud illustrates not only what Vietnam has achieved but also the limits of that success. It is a rare domestic supplier of parts to an important foreign manufacturer. But the plastic bits it makes are some of the simplest in Samsung's Galaxy phones. Moreover, its plastic-injection machines are imported from South Korea. The resin they mould into plastic comes from China. The Vietnamese stuff does not meet Samsung's quality standards, admits Mr To. This sort of work is at the lower end of the electronics value chain, rewarded with lower pay, and easier for other countries with unskilled workers to swipe.

Nor can Vietnam simply copy out of the playbook of China or South Korea. Globalisation is falling out of favour. Big markets are reshoring. Trade deals prohibit the state-aid tactics used by some other countries that went from poverty to prosperity. A former Vietnamese official notes that the Chinese government was able to set the rules for foreign companies keen to sell to China's vast market. "In Vietnam we don't have the power," she says.

Foreign investment helps, but it will take time to show results. Next year Samsung will open a research facility in Hanoi, the capital. It is also looking into setting up semiconductor factories in the country. In May Pham Minh Chinh, the prime minister, joined leaders of other South-East Asian countries for a summit with President Joe Biden in Washington. But he also used the trip to drop by the Silicon Valley headquarters of Apple, Google and Intel.

The government has its own part to play. Workers are plentiful in Vietnam but talented managers are rare. So are skilled technicians. Although

Vietnam already punches well above its income level for schooling, its university and vocational-training programmes need a boost. Michael Nguyen, the country head of Boeing, an aerospace giant that sources some parts in Vietnam, suggests firms such as his could work closely with universities to tailor training to what they need. If Vietnam is to grow as rich as China, let alone Japan, South Korea or Taiwan, it will have to invest not just in infrastructure, but also in its people. ■



链式反应

越南渐成去全球化时代的赢家

但要实现在2045年成为富裕国家的目标仍很艰巨

在越南东北部的北宁省（Bac Ninh），安东尼·苏（Antony To）神气地走在自己工厂里一排排嗡嗡作响、不断吐出滚烫塑料件的机器之间。他的公司Hanpo Vina会把这些零件送往旁边的三星工厂以及附近生产打印机、扬声器、笔记本电脑等电子产品的制造商。苏从工作台上拿起一个将被运往巴西的三星手机充电器，自豪地向记者展示。在充电器的背面，有一串激光刻印的葡萄牙语，是人们熟悉的那个全球化标记的又一个版本：Fabricado no Vietname（越南制造）。

自这个前共产主义经济体在上世纪80年代末开始开放市场、推动私营企业发展以来，“越南制造”已化为无数种语言刻在越来越多的产品上。自2000年以来，越南的GDP增速超过了除中国之外的所有亚洲国家，平均年增速为6.2%。外国大企业蜂拥而来。一开始是寻找低技能劳动力的服饰制造商，像是耐克和阿迪达斯，后来变成了电子产品热潮——这类更高价值的产品为更多高技能劳动者带来了更高薪的职位。2020年，电子产品占越南商品出口的38%，而在2010年，这个部分在一个小得多的总额中占14%（见图表）。

2018年爆发的中美贸易战推波助澜。2019年，美国有总值310亿美元原本要从中国进口的商品改为从其他低成本亚洲国家进口，其中越南占了近一半，尽管这些商品中有一部分可能只是对中国制造的产品略加改装再标上“越南制造”。

考虑到两个超级大国之间地缘政治局势日益紧张，再加上中国严格的疫情防控措施以及不断上升的劳动力成本，不难理解为什么许多大公司转向越南。苹果最大的供应商富士康及和硕（制造Apple Watch、MacBook和其他小型电子产品）正在越南建造大型工厂，看起来势将成为越南最大的雇主之一。把大量生产从中国往越南迁移的大公司还包括戴尔和惠普（笔记

本电脑）、谷歌（手机）和微软（游戏机）。

这一切可能进一步促进越南的经济增长，让数千万越南人生活更富裕，进而可能提升越南共产党（自1975年越战结束以来对越南实行一党制统治）的声望。越南政府希望越南到2045年成为富裕国家，人均GDP从目前的仅2800美元上升至超过18,000美元。它希望，从生产廉价服装转型为生产需要投资和高技能劳动力的复杂电子产品是推动实现这一目标的其中一步。

越南有很多利好因素。在中国的劳动力老化和萎缩之时，越南的劳动力仍将是年轻有活力的。越南踊跃加入了十多个自由贸易协定，能更方便地进入许多国家的市场。越南的政治领导人对新冠病毒也不像中国那么紧张。越南在3月已全面重开国门。中国仍有许多入境限制。

此外，人口约一亿的越南还拥有一些地理优势，例如超过3000公里的海岸线。而且它就在中国的“门口”。归功于新建道路等大规模基建支出，从越南的电子产业集群到中国科技之都深圳仅需12小时车程。“在这里，你根本不需要重新打造供应链。”一位工业园区运营商说。越南政府同时交好中美两国的本事也很有价值。

然而，越南的工厂若要往价值链的更高端攀升还得下大工夫。越南的制造业根基仍比中国浅薄得多。外国公司很乐意从越南当地采购更多零部件，这样会比从中国采购更快更方便，但往往求而不得。

Hanpo Vina工厂值得苏为之自豪，它是越南所取得成就的缩影。但它也暴露出这番成就的局限性。它是越南国内少有的为一家重要的外国制造商供应零部件的厂商。但它生产的塑料部件属于三星Galaxy手机中最简单的那类。而且它用的注塑机是从韩国进口的。作为注塑原料的树脂来自中国。苏承认，越南产的原料不符合三星的质量标准。这类工作处于电子制造业价值链的低端，报酬较低，也更容易被其他国家的非技术工人夺走。

越南也不能简单照搬中国或韩国的成功经验。全球化正在失势。大型市场正在部署制造业回流。某些脱贫致富的国家以往采用的政府补贴策略现在被贸易协定禁止。一位前越南官员指出，中国政府能给渴望打开中国庞大

市场的外国公司订立规矩。“在越南，我们没这本事。”她说。

外国投资会有帮助，但需要时间才能见到成效。三星将于明年在越南首都河内开设一家研究机构。它还考虑未来在越南建半导体工厂。5月，越南总理范明政和其他东南亚国家领导人一同赴华盛顿与美国总统拜登举行峰会。他也趁此行访问了苹果、谷歌和英特尔在硅谷的总部。

政府自己也要发挥作用。越南的劳动力充足，但出色的管理人才不多，高级技术人员也很少。尽管越南对教育的投入已大大领先于其收入水平，大学和职业培训仍有待加强。航空巨头波音公司在越南采购部分零件，它在当地的主管迈克尔·阮（Michael Nguyen）建议，像波音这样的公司可以与越南的大学紧密合作，按雇主的需要定制培训课程。先别说赶上日本、韩国或中国台湾的富裕程度，就是要达到中国大陆的水平，越南不仅需要投资于基础设施，还需要投资于其国民。■



Factories, flooded

A global manufacturing slowdown suggests worse is to come

Recession would be brutal for countries that have still not recovered from covid-19

“IS A GLOBAL recession imminent?” asks a new report by the World Bank. The answer—that one very well might be—will not be a surprise to manufacturers. In August global manufacturing output shrank relative to the month before, and new orders fell for the second month in a row, according to JPMorgan Chase, a bank. As economic woes mount, worse could be ahead, for factories and the broader economy.

Last year industry enjoyed an epic boom. Consumers, bolstered by generous covid-19 relief, splashed out on goods, and the easing of lockdowns allowed factories to make up lost ground. The value of global manufacturing output leapt to more than \$16trn, representing the highest share of GDP in nearly two decades. Roaring industry powered a banner year for the world economy, with overall global output rising by 6.1%, the fastest pace on record, despite supply-chain problems.

A softening of demand was inevitable as life became normal, and spending shifted back from goods to services. But even service-sector activity looks disappointing of late, and manufacturing troubles reflect much bigger shocks. The most serious is the energy-price crunch caused by Russia’s war in Ukraine. Industrial production in the euro zone fell by 2.4% in July against the year before. Firms have had to idle plants in the face of energy costs which render production uneconomical—a cold winter would bring even more pain.

The beleaguered Chinese economy is also a problem. Manufacturers struggling with “zero-covid” policies and a property-market bust were hit by an additional shock over the summer, as intense drought impeded

shipping and dealt a blow to hydropower. Data from Caixin, a business publication, show that Chinese manufacturing sales shrank in August compared with the previous month. The performance of economies which typically export lots of goods and components to China also spells trouble. South Korean production swooned over the summer, for instance, as its exports to China tumbled.

The drag from high energy costs and a limping Chinese economy has been reinforced by tightening monetary policy. Surging demand for goods over the past two years overtaxed the capacity of factories, ships and ports, pushing inflation up. High prices have proven remarkably persistent—thanks in part to the shock of the war in Ukraine—so central banks are taking aggressive action. Such synchronous tightening has occurred rarely over the past half century, notes the World Bank, and resembles the positioning which triggered a global recession in 1982.

For now, manufacturers in India and South-East Asia have resisted global headwinds. That may reflect efforts to diversify supply chains away from China. During the first seven months of 2022, China's exports of goods to America were up by 18% compared with the year before. Exports from India were up by 30%, however, while those from Vietnam were up by 33%, Indonesia by 41% and Bangladesh by 50%. Yet their fortunes are ultimately roped to the world economy as a whole; if it continues to weaken, even relatively insulated places will find it difficult to avoid a slump.

A global recession is not a foregone conclusion. Manufacturing suffered in 2015-16 and in 2019, and in both cases the economy avoided a downturn. But in these periods, policy changed dramatically to prevent weakening growth from snowballing. In the middle of the decade, the Federal Reserve raised rates far more slowly than it had led markets to expect—and China opened a fire hose of stimulus. In 2019, the Fed pivoted to rate cuts even as President Donald Trump's tax plan swelled American deficits, boosting the

world economy.

There is little immediate hope for similar reversals. China is wedded to its zero-covid policies for now, meaning new stimulus would do little to boost growth. Recently Fed officials have told markets they should expect American interest rates to rise higher and stay there for longer—even if this pushes the economy towards recession. Indeed, so long as American consumer spending remains robust, the Fed will probably feel that its inflation-fighting work is unfinished.

The safe bet is that conditions will get worse before they get better. But how much worse? The World Bank presents three scenarios for next year. The baseline is one consistent with the current consensus outlook for growth, of about 1.5% per person, but which is probably not consistent with central banks' desired fall in inflation—and which is thus almost certainly too optimistic. In a second, “sharp downturn” scenario, central banks have to work harder to arrest inflation but still fail to restore price stability, and growth decelerates to 0.8% per person. The third is one in which significant, synchronous monetary tightening induces a recession, such that global output shrinks by about 0.4% per person.

Either of the latter scenarios would be bitter for countries still recovering from the covid downturn. Debt loads around the world remain alarmingly high, and many countries' economies lag below their pre-pandemic trendline. Their leaders will be watching the slowdown in global manufacturing with considerable trepidation. ■



车间停摆

全球制造业放缓表明更糟糕的还在后头

对于那些尚未从新冠疫情中复苏的国家来说，衰退会很要命

"全球经济衰退近在眼前了吗？"世界银行的一份新报告问道。这个问题的答案——“很可能是的”——并不会让制造商感到意外。摩根大通称，8月份全球制造业产出较前一个月缩水，新订单连续第二个月下降。随着经济困境加剧，对工厂和更广泛的经济来说，情况都可能会变得更糟。

去年，工业经历了一轮飙升。在慷慨的新冠肺炎纾困措施的支撑下，消费者大把花钱购物，封锁措施的放松也让工厂得以收复失地。全球制造业产值跃升至逾16万亿美元，占GDP的比重达到近20年来的最高水平。重振雄风的工业推动世界经济迎来了丰收年，尽管存在供应链问题，但全球总产出增长了6.1%，创下历史最快增速。

随着人们生活回归正常，以及消费从商品转回服务，需求疲软不可避免地出现了。但是最近，即使是服务业的活动看起来也令人失望，而制造业的麻烦反映出的冲击要大得多。最严重的是俄乌战争导致的能源价格危机。欧元区7月的工业生产同比下降了2.4%。能源成本上涨使得生产变得不经济，企业不得不让工厂停工，而寒冷的冬天还会带来更多的痛苦。

陷入困境的中国经济也是一个问题。在“清零”政策和房地产市场低迷中挣扎的制造商今夏又遭受了另一重冲击：严重的干旱阻碍了航运，打击了水电产能。财经媒体财新传媒的数据显示，8月，中国的制造业销售较前一个月萎缩。一贯向中国出口大量商品和零部件的经济体的表现也预示着麻烦。例如，随着韩国对中国的出口大幅下降，整个夏天它的生产都萎靡不振。

高昂的能源成本和蹒跚的中国经济造成的拖累又因货币政策收紧而加重。过去两年，商品需求激增，工厂、船只和港口的产能疲于应付，推高了通胀。价格长时期居高不下——一部分原因是俄乌战争的冲击——因此各国央

行正在采取激进的行动。世界银行指出，这样的同步紧缩在过去半个世纪中罕有发生，很像在1982年引发了全球衰退的情形。

目前，印度和东南亚的制造商顶住了全球的逆风。这可能是因为在中国之外多元化供应链的努力初见成效。在2022年的前七个月，中国对美国的商品出口同比增长了18%。但印度的出口增长了30%，越南增长了33%，印度尼西亚增长了41%，孟加拉国增长了50%。不过，它们的命运终究与整个世界经济联系在一起，如果世界经济继续走弱，即使相对隔绝的地方也会发现很难避免衰退。

全球经济衰退并非已成定局。制造业在2015至2016年间和2019年遭受了打击，但那两次全球经济都避免了衰退。但在那些时期，政策发生了巨大的变化以防止增长放缓愈演愈烈。2015年前后，美联储加息的速度远低于它引导的市场预期，而中国也打开了刺激经济的水龙头。2019年，在美国时任总统特朗普的税收计划扩大了美国赤字的同时，美联储转向降息，提振了世界经济。

如今不太可能立即出现类似的逆转。中国目前坚持清零政策不放松，意味着新的刺激措施对提振增长的作用不大。最近美联储官员告知市场，称它们应该预期美国利率会升得更高并会在高位保持更久——即使这会把经济推向衰退。事实上，只要美国消费者支出保持强劲，美联储可能都会觉得自己抗击通胀的工作尚未完成。

保险的预测是情况在好转之前会变得更糟。但是会有多糟呢？世界银行对下一年设想了三种场景。作为基线的一种场景与当前对增长前景的共识相一致——1.5%的人均产出增长，但可能与央行希望的通胀下降程度不一致，因此几乎可以肯定是过于乐观了。在第二种“急剧下滑”的场景中，央行不得不下更大力气抑制通胀，但仍无法恢复价格稳定，增长放缓至人均0.8%。在第三种场景中，各国央行同步大幅收紧货币政策引发了衰退，导致全球人均产出下降约0.4%。

对于仍在努力从疫情造成的低迷中恢复的国家来说，后两种情况不管是哪

一种都将苦不堪言。全球债务负担仍处于警戒高位，而且许多国家的经济都仍低于它们在疫情前的趋势线。它们的领导人将惶恐不安地看着全球制造业放缓。 ■



The homecoming king

The world's biggest bet on India

What Tata's \$90bn pivot to its home market says about the planet's fifth-biggest economy

IF YOU WANT to glimpse the frontier of Indian capitalism, take a trip to Tamil Nadu in the south of the country. New factories with solar panels on their roofs lie on a vast 550-acre (220-hectare) site. Inside, it is reported, Tata is making components for the latest iPhones on behalf of Apple—and in the process finally connecting India to the world's most sophisticated supply chain, which used to be anchored to China.

The project is not a one-off. It is part of a new and staggering \$90bn investment surge by India's biggest business that is repositioning itself towards its home market and away from its 30-year strategy of fanning out globally. Tata's ambition to create electronics factories and semiconductor fabs in India could transform its economy. "I firmly believe that this is going to be India's decade," says Natarajan Chandrasekaran, who runs the holding company, Tata Sons, which oversees the group.

The change in strategy also reflects the dramatic psychological shift within the business world's most ardent globalisers, as they adapt to new megatrends. These include the rebasing of strategic manufacturing away from China; the rise of a new energy system; and industrial policy, which in India is being championed by Prime Minister Narendra Modi.

Anyone who follows India, the world's fastest-growing big economy, may be under the impression that it is run by Mukesh Ambani and Gautam Adani, two swaggering tycoons, whose conglomerates generate headlines and make them Asia's richest men. Together the "two As" may spend over \$100bn in the next five years. Yet Tata is in fact the country's biggest

business measured by market value (\$269bn) and operating profits (\$16bn last year), spanning everything from steel mills to software. And we estimate that its new plans are larger than any other individual firm's, encompassing electric vehicles (EVs), electronics, battery gigafactories, clean power and chips (see chart 1). If that doesn't sound ambitious enough, it has also taken on the Everest of corporate turnarounds, buying Air India.

The firm's scale, reputation and record make it one of the world's most important companies. With 800m-900m customers across ten business lines, it employs almost 1m people, more than any listed firm anywhere bar Amazon and Walmart. It is also the ultimate survivor. Of the world's firms worth over \$200bn that have remained independent, it is the oldest, founded in 1868, 18 years before Johnson & Johnson was incorporated. When blue-chip multinationals head to India—not just Apple (reportedly), but everyone from Starbucks to Zara—they seek to team up with Tata, the one firm you can really trust. In a twist, Tata is run by technocrats who report to what may be the world's least-known and richest charity, not tycoons eyeing the Forbes rich list.

To understand where Tata and India are heading in the 2020s and 2030s you have to go back in time. The company has stayed alive by adapting to technological and political change. It made steel for colonial railways, and after independence it coped with India's socialist detour. When the economy opened up in the early 1990s it helped reinvent white-collar work by selling information-technology outsourcing (IT) services. Ratan Tata, the boss between 1991 and 2012, spent the first decade dragging the group into the modern era and the second taking it global through \$18bn of cross-border takeovers, including of Jaguar Land Rover, a British carmaker, and Corus, an Anglo-Dutch steelmaker.

Tata's belief in the boundless opportunities of borderless commerce was

shared by many others at the time. Annual investment by Indian firms abroad soared almost 40-fold between 2000 and the peak in 2008; for all emerging markets it rose by four times. China urged its bosses to “go out there”. Even Cemex, Mexico’s cement giant, became an unlikely deal machine.

| *In, out, shake it all about*

Behind the boom lay insecurity as well as optimism. Tata worried India was too corrupt to offer a level playing field. More broadly it and fellow emerging-market firms believed that to tap advanced technologies you had to be in the West. Tellingly, at home in India the fashion then was for “Jugaad Innovation”: basic, frugal engineering that was supposedly a source of advantage. Tata launched the Nano, an ultra-basic car for India that cost \$2,000.

This era of reflexive corporate globalism has come to an end. Geographical sprawl weakened the finances of most multinational acquirers. In Tata’s case, we reckon that about two-thirds of its sales were abroad by 2012. Meanwhile, 70% of its capital employed earned a return of less than 10%, our yardstick for underperformance. Net debt had risen to twice gross operating profit. The strain helped trigger a governance crisis as Mr Tata fell out with his successor, Cyrus Mistry, whose family own 18% of Tata’s holding company (Mr Mistry died in a car crash near Mumbai on September 4th). In early 2017 Tata replaced him with Mr Chandrasekaran, the meritocrat’s choice, who had run the thriving IT business that had kept the group afloat.

The rise of Mr Chandrasekaran to the pinnacle of Asian business illustrates another sharp change: emerging markets’ technological self-confidence. In the past decade India has created perhaps the world’s most advanced payments systems and a venture-capital scene that has helped fund (at least before the recent worldwide tech slump) more than 100 private tech

“unicorns” valued at \$1bn or more. The IT-services firms, including Tata’s, have more than doubled in size and are far more technically sophisticated. And though Tata might not like to admit it, Mr Ambani’s landmark \$46bn ten-year investment in Jio, a domestic 5G telecoms business, has shown that you can profitably deploy vast sums of capital in cutting-edge tech in a developing economy.

More self-confidence in tech has coincided with the last shift, the changing relationship between the role of businesses and the state, championed by Mr Modi’s government. A move in supply chains away from China, new technologies and the energy transition all create opportunities. But who will exploit them?

The usual suspects are not up to snuff. India’s state-run firms are hopeless. Foreign multinationals have ushered in neither industrialisation nor technological breakthroughs. Capital markets have failed to create young firms with enough equity to take big risky bets. India’s last investment cycle, an infrastructure boom in 2003-11, was debt-fuelled and ended in tears. The government and some bosses now favour giant firms. Those include conglomerates as well as specialist companies like JSW Steel and HDFC, a bank which is concluding a \$140bn mega-merger.

Some firms, such as Adani Group and Mr Ambani’s Reliance, embrace this role and the proximity to the state it brings. Others are making a more calculated bet that the demands of national development and responsible, profitable business really are compatible. Tata is in the second camp.

As boss, Mr Chandrasekaran is quick and ultra-rational, with a dash of humour, compared with the aristocratic and enigmatic Mr Tata. Emails are dispatched fast. Satraps running subsidiaries are told to deliver performance first and get capital later. Tata’s worst bits are being quietly killed off: Tata Sons has written off \$10bn since 2017 as it has exited weak

areas like telecoms, and recapitalised fragile divisions.

Some of Tata's domestic laggards have got their act together. The cyclical steel business is booming, for now, and Tata's market share in cars has surged, especially for electric vehicles (even though its best-selling Nexon EV costs \$17,000 more than the abandoned Nano). The clean-up operation is roughly two-thirds complete and as a result of it, we calculate that Tata's return on capital has reached 21%, or 14% excluding IT services. The share of capital underperforming by our 10% yardstick is down to 48% (see chart 2). Leverage is less than half what it was. By our maths a share in Tata Sons has outperformed India's stockmarket by 46 percentage points since 2017. A legal battle over the succession ended when India's Supreme Court ruled in Tata's favour last year. In February Mr Chandrasekaran was appointed for another five years.

Something striking is also happening. Tata is becoming more Indian for the first time since the 1990s. Sales from the subcontinent reached 38% of the total last year, having grown almost twice as fast as foreign ones in the past decade. The plan for the next five years will accelerate this by deploying an estimated \$90bn of capital, mostly in India and mostly in projects that have a technological edge and are compatible with the government's agenda. Some are plays on growing consumption in India, others on manufacturing for export. Mr Chandrasekaran spies a "global opportunity for global companies to create a supply chain based in India".

| *Chandra's capex challenge*

Tata's annual capital spending will rise to \$18bn, more than twice the average of the past decade, we reckon. That would make it India's biggest investor. Tata and Reliance together account for 7% of the total for all private firms. If all goes to plan, new, higher-tech businesses could rise from a quarter of Tata's capital employed to half by 2027. Some 77% of Tata's new investments will be in India. These are large and potentially

transformational shifts—for the firm and the country alike.

That money is going into several bets. One is on the energy transition. Tata's power subsidiary will invest almost \$10bn over the next five years in renewable generation. There is a \$5bn project to build gigafactories in India and Europe, to supply Tata's own cars and those of other manufacturers. The Indian car operation is launching ten EV models (it has just bought Ford's plant in Gujarat). And Tata will ramp up the manufacturing of solar panels, a business China dominates today.

Another wager is on tech and electronics. Tata has invested \$1bn so far in electronics manufacturing for Indian and global customers, mainly in Tamil Nadu, and there is more to come. It intends to make 5G telecoms gear using the software-heavy OpenRAN standard, and challenge Huawei, China's hardware-focused champion. It is entering semiconductor testing and packaging (the final, less intricate stage of chip fabrication) and Mr Chandrasekaran is weighing up building what may be the first fully fledged semiconductor "fab" in India, in partnership with a foreign firm. The factory, which could cost \$5bn or more to build, would not make chips as advanced as those of Taiwan's TSMC. But it would be a leap for India and, Mr Chandrasekaran concedes, the biggest challenge for all of Tata Group. There are other contenders, too: on September 13th Vedanta, an Indian-focused firm, and Foxconn, from Taiwan, said they would invest \$19.5bn in a semiconductor plant in Gujarat.

The third gamble involves the Indian consumer. The firm has spent \$2bn on a digital platform and app called Neu that aspires to be a "superapp" for Tata customers, linking them to its retail, hotel, health-care, transport and financial services, and to products including cars. It has amassed 17m users since its launch in April—a tad disappointing, but the plan is to keep investing, particularly as some startups with competing services are now being starved of cash by a global venture-capital crunch.

Lastly there is Air India, the perennially troubled flag carrier. Before you wince, consider its selling point: it owns international slots for a huge aviation market, was bought from the state for a meagre \$350m, debt-free, and can be merged with Vistara, a domestic airline joint-venture Tata has with Singapore Airlines. The idea is to create a powerful national airline like Emirates or Lufthansa, which India has always lacked. Press reports suggest that Tata may soon buy 300 new aircraft.

These bets could sour. Tata is doubling down on being a conglomerate, opting for geographic concentration but sectoral diversification. In India, and many emerging economies, conglomerates have advantages: brand presence, clout with regulators, shared access to scarce land. But they bring complexity: Tata's holding company has over 30 big operating and 286 legal subsidiaries and Mr Chandrasekaran is on the board of seven listed firms.

Although Tata is huge, it lacks global scale in individual industries. Its \$1bn bet on electronics is equivalent to 8% of the capital of Foxconn, the leading contract manufacturer: it must deploy much more cash to truly compete. The \$5bn investment in batteries amounts to 40% of the plant of CATL, the top Chinese firm. In India Reliance's two main specialisms, in 5G, and petrochemicals and refining, each has double the capital of Tata's largest subsidiaries. A lack of focus could make technical breakthroughs harder. The boss of a big chipmaker is sceptical that India can build a globally competitive fab: "It's too soon."

Another risk is Tata's ownership. It has three layers. At the top are self-governing charitable trusts that together own 66% of Tata Sons. They are chaired by Mr Tata, with other venerable directors. They are asset-rich—together the trusts are worth \$100bn, more than the Gates Foundation—but income-poor, getting dividends equivalent to under 1% of the group's operating profits. Below them is Tata Sons, the middle layer, which Mr Chandrasekaran runs and which has stakes in the operating

companies, the third layer.

A few things may destabilise this structure. The death of Mr Mistry, and of his father in June, could lead to a reappraisal by his family of their 18% stake in Tata Sons. They have the right to sell the stake to the company, which would force it to scramble to raise \$27bn of cash to finance the purchase. Mr Tata himself is 84 and, though still mentally sharp, physically frail. When he retires from the trusts, as is likely, it is unclear who will inherit the de facto leadership of the trust boards. The hope is that a consensus forms, or a strong and respectable candidate emerges who doesn't meddle in the business. The nightmare scenario is a power struggle, or someone cosy with the government gaining sway.

The final risk is the government. The prime minister's critics fear that he is presiding over crony capitalism, pointing to exhibit "two As". Some of this is over the top. India's business scene is slightly less concentrated than America's: the four biggest groups have operating profits of 1.1% of GDP, compared with 1.2% in America. Unlike classic rent-seeking firms, India's giants are reinvesting furiously.

But even Tata, which considers itself aloof from politics, has paid symbolic homage to Mr Modi's populist nationalism. In 2019 Mr Tata visited the headquarters of the RSS, the Hindu-chauvinist association that backs Mr Modi. In the same year Mr Modi attended the launch of a book by Mr Chandrasekaran. The Tata charities are also working more closely with the state, for example on hospitals. And Tata is participating in India's \$26bn manufacturing-subsidy scheme (though it insists the handouts are too small to swing investment decisions).

For the time being Mr Modi's firm hold on power and vision for the economy are tailwinds. But that could change. Unlike the chaebol which made South Korea rich by exposing the country to global competition

through export markets, some of India's big firms are eyeing the domestic market only. They could become too cosy or corrupt. As a handful of giants diversify at home they will increasingly overlap, as they already do in renewable energy. When all that happens, can Tata be sure of equitable treatment? And when some of Tata's new bets fail, as some surely will, can it be sure it can exit even if that deprives India of a presence in an industry the government regards as "strategic"?

Some of the reasons for Mr Tata's wariness of investing in India in the 2000s still hold. Deploying tens of billions of dollars at home is a risky game. If it works, though, Tata and others may finally industrialise and digitise India, turning it into a source of innovation and manufacturing for Indians and the world. To see which way the country goes, follow Tata. ■



王者正归来

对印度的全球第一大押注

塔塔砸900亿美元转向本土市场。这透露了关于全球第五大经济体的什么信息【深度】

如果你想一睹印度资本主义的前沿阵地，请前往该国南部的泰米尔纳德邦。在一个占地550英亩（220公顷）的宽阔厂区上建起了屋顶上装有太阳能电池板的新工厂。据报道，在工厂内部，塔塔（Tata）正在为苹果公司制造最新款iPhone的组件——在此过程中最终把印度连接到了全世界最复杂的一条供应链上。这条供应链曾经牢牢扎根于中国。

这不是个一次性的项目。这是印度最大的企业900亿美元的大手笔新投资的一部分。这家公司正在抛弃它30年来的全球扩张战略，重新定位到国内市场。塔塔在印度开设电子工厂和半导体工厂的雄心可能会改变该国经济。“我坚信这将是印度的十年。”监管该集团的控股公司塔塔之子（Tata Sons）的负责人陈哲（Natarajan Chandrasekara）说。

这种战略改变也折射出商业世界中最热忱的全球化者正在经历的巨大心理转变。他们正在适应新的宏大趋势，包括战略制造业迁离中国、一个新的能源体系兴起，以及各国积极推行产业政策——在印度由总理莫迪倡导。

任何关注印度这个全球增长最快的大型经济体的人，可能都会觉得它是由穆克什·安巴尼（Mukesh Ambani）和高塔姆·阿达尼（Gautam Adani）这两位趾高气昂的大亨经营的。二人的企业集团频繁登上新闻头条，让他们晋身亚洲首富。未来五年，“双A”可能会总共花费超过1000亿美元。然而，按市值（塔塔为2690亿美元）和营业利润（去年为160亿美元）衡量，塔塔才是该国最大的企业，其业务涵盖从钢铁厂到软件的各个领域。而且，我们估计它的新计划规模超过其他任何公司，包括电动汽车（EV）、电子产品、电池超级工厂、清洁能源和芯片（见图1）。如果这听起来还不够雄心勃勃，那么它还承担起了挽救企业命运的最高难度挑战——它收购了印度航空。

该公司的规模、声誉和业绩使其成为世界上最重要的公司之一。它的十条业务线拥有8至9亿客户，雇有员工近100万，超过除亚马逊和沃尔玛以外的任何上市公司。它也是终极幸存者。在全球价值超过2000亿美元的独立企业中，它是历史最悠久的公司，成立于1868年，比强生公司还早了18年。当蓝筹跨国公司前往印度时——不仅有苹果（据报道），还有从星巴克到飒拉（Zara）的各种公司——它们寻求与塔塔这家唯一真正可信任的公司合作。在一次转折后，现在管理塔塔的不是寻求跻身福布斯富豪榜的大亨，而是一些技术专家，向可能是世界上最不知名却最富有的一家慈善机构汇报工作。

要理解塔塔和印度在2020年代和2030年代的发展方向，就必须先回头看看历史。这家公司通过适应技术和政治变革保持活力。它在殖民时期为铁路制造钢材，在印度独立后也挺过了社会主义时期。当印度经济在1990年代初期开放时，它通过销售信息技术外包（IT）服务帮助重塑了白领工作。在1991年至2012年间，担任老板的拉坦·塔塔（Ratan Tata）用头十年奋力将集团拖入现代时期，在第二个十年通过180亿美元的跨境收购将它推向全球，其中包括对英国汽车制造商捷豹路虎和英荷钢铁制造商康力斯（Corus）的收购。

那时的塔塔信仰无国界贸易带来的无限机会，许多人持同样的看法。从2000年到2008年的高峰，印度公司在海外的年度投资飙升了近40倍，同时期所有新兴市场整体增长了四倍。中国敦促企业家“走出去”。甚至墨西哥水泥巨头西麦斯（Cemex）也出人意料地成为了一台交易机器。

| 进去，出来，摇一摇

这场繁荣的背后不仅有乐观情绪，还有不安全感。塔塔担心印度过于腐败，无法提供公平的竞争环境。更广泛来说，它和其他新兴市场的公司认为，要利用先进技术就必须身在西方。很能说明问题的是，当时在印度国内流行“俭约创新”（Jugaad Innovation）：朴素、节俭的工程制造被认为是优势的来源。塔塔推出了一款面向印度的超基础型汽车Nano，售价2000美元。

这个自反性企业全球化时代已经结束。地域扩张削弱了大多数跨国收购者的财务状况。就塔塔而言，我们估算到2012年，其大约三分之二的销售额是从国外取得。与此同时，其已动用的资本中有70%的回报率低于10%——我们的衡量标准视10%以下为业绩不佳。净债务已升至营业总利润的两倍。财务压力引发了一场治理危机，拉坦·塔塔和他的继任者赛勒斯·米斯特里（Cyrus Mistry）发生了争执，后者的家族目前拥有塔塔控股公司18%的股份（米斯特里于9月4日在孟买附近的一场车祸中丧生）。2017年初，公司任人唯贤，选择陈哲取而代之。陈哲此前管理蓬勃发展的IT部门，这部分业务维持了集团的生存。

陈哲平步青云到了亚洲商界的顶峰，这体现了另一个剧烈的转变：新兴市场的技术自信。在过去的十年里，印度创造了可能是世界上最先进的支付系统，还有一个活跃的风险投资环境，它（至少在最近的全球科技衰退之前）帮助资助了100多家价值10亿美元或以上的私营科技“独角兽”。包括塔塔在内的IT服务公司的规模扩大了一倍多，技术成熟度也已大幅提升。尽管塔塔可能不大愿意承认这一点，但安巴尼10年来对本土5G电信商Jio具有里程碑意义的460亿美元投资表明，在一个发展中经济体中，你可以将巨额资本投入到尖端技术中获利。

对科技的更多自信恰逢全球大趋势的最后一项，即企业与国家之间的关系在转变。莫迪政府推崇这种转变。供应链远离中国、新技术和能源转型都创造了机会。但是谁来抓住它们呢？

通常会想到的那些公司都不够格。印度的国营企业毫无希望。外国跨国公司没有带来产业化，也没有带来技术突破。资本市场未能创造出拥有足够资本的年轻公司来承担高风险的赌注。印度的上一个投资周期（2003至2011年的基础设施繁荣）是由债务推动的，以失败告终。莫迪政府和一些老板现在偏爱超大企业。其中包括大型企业集团，以及京德勒西南钢铁（JSW Steel）和HDFC银行等专业公司，该银行正在完成一项价值1400亿美元的大型合并。

一些公司，如阿达尼集团（Adani Group）和安巴尼的信实工业

（Reliance）拥抱了这个角色，以及由此而来的与政府亲近的关系。其他人则更加慎重地下注，认为国家发展的需求和负责任的、有利可图的商业确实能相容。塔塔属于第二阵营。

作为老板，比起贵族身份的神秘的拉坦·塔塔，陈哲反应迅速、极其理性，还带有一丝幽默感。邮件发得很快。子公司负责人被告知要先拿出业绩才能获得资金。塔塔最糟糕的部分正悄然消失：自2017年以来，塔塔之子已经减记了100亿美元，因为它已经退出了电信等薄弱领域，并对脆弱的部门进行了资本重组。

塔塔在国内的一些落后业务已经开始奋起直追。目前，周期性钢铁业务生意兴隆，塔塔在汽车领域的市场份额激增，尤其是电动汽车（尽管其最畅销的Nexon EV比已停产的Nano贵1.7万美元）。清理工作大约完成了三分之二，我们由此计算出塔塔的资本回报率已达到21%，排除IT服务后为14%。按照我们10%的标准，表现不佳的资本份额已降至48%（见图2）。杠杆率不到原来的一半。根据我们的计算，自2017年以来，塔塔之子的股票表现比印度股市高出46个百分点。当印度最高法院去年做出有利于拉坦·塔塔的裁决时，一场关于继承的法律战宣告结束。2月，陈哲又被任命了五年。

还有一些惊人的事情正在发生。塔塔自1990年代以来首次变得更加印度化。去年，来自印度次大陆的销售额达到了总销售额的38%；这部分在过去十年中的增长速度几乎是海外销售额的两倍。未来五年的计划将通过部署大约900亿美元的资金来加速这一进程，这些资金主要在印度，并且多数用于具有技术优势且符合政府计划的项目。有些是抓住印度不断增长的消费，有些则是针对出口制造业。陈哲发现了“全球公司在印度建立供应链的全球机会”。

| 陈哲的资本支出挑战

我们估计，塔塔的年度资本支出将增至180亿美元，是过去十年平均水平的两倍多。这将使其成为印度最大的投资者。塔塔和信实合计占有所有私营公司投资总数的7%。如果一切按计划进行，到2027年，新的高科技业务

可能会从占塔塔资本支出的四分之一增加到一半。塔塔约77%的新投资将在印度。对于公司和国家来说，这些都是巨大的、可能改变局面的变化。

这些钱将被投注到几个方面。一是能源转型。塔塔的电力子公司将在未来五年内投资近100亿美元用于可再生能源发电。有一个50亿美元的项目将在印度和欧洲建造超级工厂，以供应塔塔自己的汽车和其他制造商的汽车。塔塔汽车公司正在推出十款电动汽车（它刚刚收购了福特在古吉拉特邦的工厂）。塔塔还将扩大太阳能电池板的产能，中国目前在这个领域居主导地位。

另一个赌注是科技和电子产品。到目前为止，塔塔已经为面向印度和全球客户的电子制造（主要在泰米尔纳德邦）投资了10亿美元，未来还会投入更多。它打算使用偏重软件的OpenRAN标准制造5G电信设备，并挑战中国以硬件为重点的领军企业华为。它正在进军半导体测试和封装（芯片制造中最后一个不那么复杂的阶段），同时陈哲正在斟酌与一家外国公司合作在印度建立可能是第一个完全成熟的半导体“晶圆厂”。这家造价可能在50亿美元以上的工厂制造出的芯片不会像台积电的那样先进。但这对印度来说会是一个飞跃，而陈哲也承认这对塔塔集团来说是最大的挑战。他也面对其他竞争者：9月13日，专注于印度本地的公司瓦达塔（Vedanta）和富士康表示将投资195亿美元，在古吉拉特邦建设一家半导体工厂。

第三个赌局涉及印度消费者。塔塔已在一个名为Neu的数字平台和应用上花费了20亿美元，希望它成为塔塔客户的“超级应用”，把他们连接到它的零售、酒店、医疗、交通和金融服务以及汽车等产品上。自4月推出以来，它已经积累了1700万用户——这个数字有点令人失望，但塔塔的计划是继续投资，特别是眼下因全球风险资本紧缩，一些提供竞争服务的创业公司已经现金不足。

最后是印度航空，一家常年深陷困境的旗舰航空公司。在你被吓退之前，想想它的卖点：它拥有一个庞大的航空市场的国际航班席位，以区区3.5亿美元的价格从国家手中买来，无债务，并且可以与塔塔和新加坡航空公司合资创办的国内航空塔新航空（Vistara）合并。塔塔的想法是创建一家像

阿联酋航空或汉莎航空这样强大的国家航空公司，这是印度一直缺少的。从新闻报道看，塔塔可能很快就会购入300架新飞机。

这些赌注可能会变糟。塔塔正在加倍努力成为一家企业集团，它选择在地域上集中而部门多元化。在印度和许多新兴经济体，企业集团具有优势：品牌影响力、对监管机构的影响力、共享稀缺土地的使用权。但它带来了复杂性：塔塔的控股公司拥有30多家大型运营子公司和286家法律形式子公司，而陈哲是七家上市公司的董事会成员。

塔塔虽然整体规模庞大，但在单个行业中缺乏全球规模。它在电子产品上的10亿美元赌注相当于领先的代工制造商富士康资本的8%——若想要真正参与竞争，它还必须部署多得多的现金。50亿美元的电池投资相当于中国最大电池制造商宁德时代（CATL）工厂投资的40%。在印度信实的两个主要专业领域——5G以及石化和炼油领域——资本投入都是塔塔最大子公司的两倍。缺乏重点可能会使技术突破更难取得。一家大型芯片制造商的老板对印度能建立具全球竞争力的晶圆厂持怀疑态度：“现在还时为过早。”

另一个风险是塔塔的所有权。它有三层。最上层是自治的慈善信托基金，它们共同拥有塔塔之子的66%。它们由拉坦·塔塔担任主席，其他董事也德高望重。它们资产充沛——这些信托加起来价值1000亿美元，比盖茨基金会还多——但收入很低，获得的股息不到集团营业利润的1%。在它们之下是塔塔之子，即中间层，由陈哲经营，并持有位于第三层的运营公司的股份。

有几件事可能会破坏这种结构的稳定性。米斯特里的去世，加上他父亲在6月去世，可能会导致其家人重新评估在塔塔之子中18%的股份。他们有权将股份出售给公司，这将迫使公司手忙脚乱地筹集270亿美元现金来为此次收购提供资金。拉坦·塔塔已经84岁了，虽然头脑还很敏锐，身体已较虚弱。当他从信托公司退休时——这个可能性很大——目前还不清楚谁将继承信托委员会的实际领导权。最好是能形成共识，或者出现一个不干涉业务的强大而受人尊敬的候选人。一个噩梦般的场景是一场权力斗争，或者是由与政府关系亲密的人掌权。

最后一个风险是政府。总理的批评者担心他正在领导裙带资本主义，并直指“双A”。其中一些声音有些过头了。印度的商业格局比美国的集中度略低：前四大集团的营业利润占GDP的1.1%，而美国为1.2%。与传统的寻租公司不同，印度的巨头们正在疯狂地进行再投资。

但即使是自认为远离政治的塔塔，也已象征性地向莫迪的民粹民族主义致敬。2019年，拉坦·塔塔访问了支持莫迪的印度教沙文主义者团体“国民志愿服务团”（RSS）的总部。同年，莫迪出席了陈哲的新书发布会。塔塔慈善机构也在与国家进行更密切的合作，例如在医院方面。塔塔也参与了印度260亿美元的制造业补贴计划（尽管它坚称这些补贴数目太小，不足以影响自己的投资决策）。

目前，莫迪对权力的牢牢把控和对经济的愿景可谓是顺风。但这可能会改变。与通过出口市场让韩国面临全球竞争而使韩国变富裕的财阀不同，印度的一些大公司只关注国内市场。它们可能变得过于安于现状或腐败。随着少数几家巨头在国内实现多元化，它们的业务将有越来越多的重叠，正如在可再生能源领域已经出现的情况那样。当这一切发生时，塔塔能确保自己享有公平的待遇吗？而当塔塔的一些新赌注失败时（有些肯定会失败），如果退出会让印度在其政府视为“战略性”的行业中惨淡收场，它又是否能确保自己能够退出？

拉坦·塔塔在2000年代对投资于印度本土态度谨慎的一些原因如今仍然成立。在国内部署数百亿美元是一场冒险的游戏。不过，如果它奏效了，塔塔和其他公司可能最终能实现印度的工业化和数字化，将它变成印度人和全世界的创新和制造源泉。要了解这个国家的发展方向，请关注塔塔。





Population and prosperity

More people mean more innovation, not just more consumption

So a rising population can solve many of the problems it causes, argues “Superabundance”

Superabundance: The Story of Population Growth, Innovation and Human Flourishing on an Infinitely Bountiful Planet. By Marian Tupy and Gale Pooley. Cato Institute; 655 pages; \$34.95

IN 1980 CHINESE officials met to discuss birth control. One of them, Song Jian, had just returned from Europe, where he had read two influential books: “The Limits to Growth” (published by the Club of Rome, a think-tank), and “A Blueprint for Survival” (based on an article in the Ecologist magazine). Both argued that a growing population would deplete Earth’s resources, with results including “the breakdown of society and the irreversible disruption of life-support systems on this planet”.

Mr Song helped persuade China’s Communist Party to enforce a merciless one-child policy for 35 years. Couples with excess babies were hit with ruinous fines; the homes of some were bulldozed. Illegal children were denied public services or put up for adoption abroad. Women pregnant with a second child were tied down and subjected to late-term abortions. Some officials drowned illicit babies in buckets.

China’s one-child policy is an extreme example of what Marian Tupy and Gale Pooley call “anti-humanism”: the belief that people are a burden on the planet, and so the fewer of them there are, the better. A few environmentalists espouse grotesque versions of this view. The authors quote Christopher Manes, who suggested that HIV/AIDS was “the necessary solution” to overpopulation. Others, such as Alexandria Ocasio-Cortez, a star of America’s Democratic Party, merely question whether it is ethical to

have children. She is far from alone: according to an international poll, a hefty 39% of people hesitate to procreate for environmental reasons.

Mr Tupy, who works for the Cato Institute, a libertarian think-tank, and Mr Pooley (of Brigham Young University), think people should be free to have the number of children they want. Because they have brains as well as mouths, they argue, more people mean more innovation—which in turn means many of the problems caused by a rising population can be solved by it.

This is not a new idea. It was the inspiration behind a bet between the late Julian Simon, an economist, and Paul Ehrlich, a population alarmist, in 1980. Mr Ehrlich was sure that the world was running out of stuff, so a basket of commodities (chromium, copper, nickel, tin and tungsten) would get more expensive over the next decade. Simon reckoned human ingenuity would unlock new resources, so they would get cheaper. Simon won the bet.

Mr Tupy and Mr Pooley have broadened the scope of Simon's analysis. They look at a wider range of goods over a longer period of time (some of their data goes back to 1850). And they use a different measure of value. Instead of relying on prices in dollars and adjusting for inflation, which is hard to do accurately across borders and eras, they look at "time-prices": how long it takes to earn enough to buy something. If someone earns \$10 an hour and a banana costs \$1, for example, the time-price of a banana is six minutes.

As well as being robust, the method yields some cheering results. The average time-price of a basket of 50 commodities, from uranium and rubber to tea and shrimp, fell by 72% worldwide between 1980 and 2018. Resources are becoming more abundant (ie, available to more people) as new ways to find and exploit them are invented. The time-price of many manufactured

goods fell even faster. In 1997 it took a typical blue-collar worker in America 828 hours to buy a flat-screen television; by 2019 that had fallen to 4.6 hours.

Time-prices suggest the world is getting richer at a cracking pace (with the odd hiccup when there is a pandemic or war). They also offer a fresh perspective on global inequality. By the authors' calculations, in 1960 a typical Indian had to toil for seven hours to put rice on the family table, while a typical American had to work for one hour to buy enough wheat. For their grandchildren in 2018 those figures had fallen to 58 minutes and 7.5 minutes respectively.

Thus in 1960 the Indian worked 7 times longer to buy food; that ratio rose to 7.7 for his grandson, suggesting that inequality has increased. But another interpretation is that the Indian gained 362 minutes a day, while the American gained a seventh of that. "Time inequality between the two has declined dramatically," the authors judge. "When basic things get more abundant, it's the poor who benefit the most."

Past progress is widely underestimated, they argue, and the future is probably rosier than most people imagine. Plenty of things could go wrong, they concede. Restraints on free speech could stifle innovation; governments could muffle market forces, reducing the incentive to develop new ideas. They devote too little space to climate change, but their main suggestion—that more research will be required to make nuclear power cheaper and safer—is right as far as it goes.

This book has other small flaws, among them the subtitle: no planet can be "infinitely bountiful". But overall it is brain-stretching, optimistic and humane. ■



人口与繁荣

人多不只消耗多，创新也更多

所以这本书认为不断增长的人口能解决自身造成的很多问题【《超富余》书评】

《超富余：一个资源取之不尽的地球上人口增长、创新和人类繁荣的故事》，玛利安·图皮和盖尔·普利著。卡托研究所，655页，34.95美元。

一九八〇年，中国官员开会讨论计划生育。与会官员之一是刚从欧洲回来的宋健，他在那里读到了两本颇具影响力的著作：《增长的极限》（The Limits to Growth，智库罗马俱乐部出版）和《生存蓝图》（A Blueprint for Survival，以《生态学家》杂志上的一篇文章为基础写成）。两本书都认为，不断增长的人口将耗尽地球资源，其后果包括“社会瓦解和地球生命支持系统受到不可逆转的破坏”。

宋健等人说服中国共产党施行了长达35年残酷无情的独生子女政策。超生夫妇被罚到倾家荡产。有些人的房子被夷为平地。超生儿不可享受公共服务，或被安排让外国人收养。怀二胎的妇女被绑起来做大月份引产手术。一些官员用水桶溺死超生婴儿。

中国的独生子女政策是玛丽安·图皮（Marian Tupy）和盖尔·普利（Gale Pooley）所说的“反人文主义”的一个极端例子。反人文主义认为人是地球的负担，所以人口越少越好。个别环保主义者还会把这种观点的荒唐版本奉若圭臬。作者们引用了克里斯托弗·马内斯（Christopher Manes）的话，他认为艾滋病是人口过剩的“必要解决方案”。包括美国民主党名人亚历山德里娅·奥卡西奥-科尔特斯（Alexandria Ocasio-Cortez）在内的一些人直接质疑生孩子是否道德。有这种质疑的人远不止她一个。根据一项国际民意调查，高达39%的人因环境原因对生育有顾虑。

在自由意志主义智库卡托研究所（Cato Institute）任职的图皮和杨百翰大学（Brigham Young University）的普利认为，人们应该可以想生几个孩子就生几个。因为孩子不仅会张嘴吃饭，还会用脑思考，所以人多也意味

着创新更多，他们认为这些创新反过来又会解决人口增长带来的许多问题。

这个观点并非首创。已故经济学家朱利安·西蒙（Julian Simon）和人口悲观论者保罗·埃利希（Paul Ehrlich）在1980年打了一个赌，赌的就是人口与创新的关系。埃利希深信全球资源正在耗尽，所以一篮子商品（铬、铜、镍、锡和钨）的价格将在随后的十年升高。西蒙则认为人类的聪明才智将释放新资源，因此这些商品会更便宜。最终西蒙赢了。

图皮和普利扩大了西蒙的分析范围。他们研究了更多的商品在更长的时间跨度里的价格变化（部分数据可以追溯到1850年）。他们还使用了不同的价值衡量标准。他们不依赖美元价格并调整通胀因素，因为这种方法很难跨国界和时代得到准确结果。他们关注“时间价格”，即需要多长时间才能赚够买某样东西的钱。例如，如果某人时薪10美元，而一根香蕉的价格是1美元，那么一根香蕉的时间价格就是6分钟。

除更可靠外，这种方法得出了一些令人振奋的结果。从1980年到2018年，从铀和橡胶到茶叶和虾的一篮子50种商品的平均时间价格在全球范围内下降了72%。随着人们发明出更多找到和利用资源的方式，资源正变得日益丰富充裕（即让更多人用得到）。许多制成品的时间价格跌得还要快。1997年，一个普通美国蓝领工人需要工作828小时才能买一台平板电视。到2019年，这个数字已降至4.6小时。

时间价格表明，世界正以惊人的速度变得更加富足（在发生大流行病或战争时会偶尔卡壳）。它们也为全球不平等问题提供了新的视角。据作者们计算，在1960年，一个普通印度人需要辛勤工作7小时才能让家人吃上米饭，而一个普通美国人得工作1小时才能买到足够的面粉。到了2018年他们孙儿这一辈，两个数字分别下降到58分钟和7.5分钟。

因此，在1960年，一个普通印度人为购买食物而工作的时长是美国人的7倍；到了他们的孙辈，这个数字上升到了7.7，表明不平等有所加剧。但另一种解释是，印度人每天节省下了362分钟，而美国人节省下的时间是这

个数字的七分之一。“两者之间的耗时不平等急剧缩小，”作者们判定，“当基本商品变得更丰富时，受益最多的是穷人。”

他们认为，过去的进步被广泛低估了，而未来可能比大多数人想象的更美好。他们也承认可能会出现各种问题。限制言论自由可能会扼杀创新，政府可能会压制市场力量，削弱提出新想法的动力。他们花在气候变化上的篇幅过少了，但他们的主要提议本身是对的，即需要展开更多研究来让核能变得更便宜、安全。

这本书还有其他一些小缺陷，副标题是其一——没有哪个星球可能是“资源取之不尽”的。但总体而言，它让人跳出思维的框框，乐观且充满人情味。■



Decline and punishment

Japan's prisons are adapting to cope with ageing inmates

The harsh traditional regimen is not good for dementia

AT FUCHU PRISON, in western Tokyo, an octogenarian lobs coloured bean bags onto a table. Behind him, a silver-haired inmate sits hunched at a computer, doing arithmetic and responding to quiz questions like: "Is a dandelion a flower?" Others fold origami paper into pentagons. Repetition and practice help to "stimulate their minds", says a watching officer.

Fuchu is one of a handful of prisons trying out rehabilitation programmes aimed at maintaining older inmates' physical and mental health. The puzzles and games are designed to curb the development of dementia in their participants. Authorities are wary because Japan's prisoners, like the rest of its population, are getting older. In June the government decided to amend the penal code, bringing programmes such as this to prisons across the country.

The ageing of Japan's lawbreakers is reflected in the crime statistics. The number of offenders over the age of 65 has more than doubled over the past 20 years. Elderly criminals are now more likely than younger ones to reoffend and end up back in jail. The justice ministry reckons some 14% of inmates over the age of 60 have symptoms of dementia.

Traditionally, Japan's prisons have been highly punitive. Inmates atone for their crimes through forced labour. Talking is banned during much of the day; recreational activities such as reading are allowed only at allotted times. Inmates live "like robots", says Hamai Koichi, a former justice-ministry official, now a criminologist at Ryukoku University in Kyoto.

That harsh monotony can accelerate cognitive decline. Some convicts see it

looming in those around them. “Most of the inmates who are older than me keep saying the same thing over and over,” frets a 71-year-old at Tochigi prison, north of Tokyo. “I don’t want to become like them.”

Growing numbers of aged inmates had already pushed prisons to become a bit more considerate, informally at least. Older inmates struggle to keep up with tasks, so prisons reduced their workloads. Social workers and carers were brought in to supplement guards. Many prisons have put in handrails. Some serve puréed food for those with trouble chewing. “As prisons started to look more like nursing homes, government officials began questioning their approach,” says Mr Hamai.

The amendment to the penal code—the first since the law was passed in 1907—is meant to codify this shift to a more benevolent approach. Labour will no longer be mandatory. Prisons will offer educational programmes in an effort to help criminals rejoin society, thereby curbing recidivism. But the penal system lacks both the money and the manpower to implement more intensive rehabilitation programmes. Experts worry that inmates may not understand the purpose of activities, and that forcing them to participate against their will could be harmful.

The government has avoided deeper reform. It has not considered relaxing sentencing guidelines in such a way as to limit elderly incarceration, or considered offering an amnesty to older inmates. Most crimes committed by older people in Japan are petty, such as theft and shoplifting. They are often driven by poverty and loneliness. But repeated misdemeanours can still land offenders behind bars for years.

“It’s nice that they’re introducing rehabilitation programmes, but I can’t help thinking: why are these people even in prison?” says Yasuda Megumi of Kokugakuin University in Tokyo. She believes reinforcing the safety net would be more effective.

The tension is most acute when it comes to prisoners with dementia. Japanese law prohibits jailing people with psychological disorders, especially if they cannot understand why they are being punished. That rule is rarely followed. The numbers of prisoners with dementia is therefore likely to grow. Igarashi Hiroshi, the founder of Mother House, a non-profit organisation focused on rehabilitation of ex-convicts, puts it well: “There’s no use telling someone with dementia to regret their mistakes.” ■



衰与罚

日本监狱调整应对囚犯老龄化

严厉惩戒的传统制度对痴呆症无益

在东京西郊的府中监狱，一名八十多岁的老人往一张桌子上扔彩色豆袋。在他身后，一名满头银发的囚犯弓着背坐在电脑前，做算术和回答诸如“蒲公英是花吗？”之类的问题。其他人在用折纸折五边形。重复和练习有助于“刺激他们的大脑”，一名执勤狱警说。

府中等一小批监狱正在尝试的囚犯改造更生项目旨在维持老年囚犯的身心健康。问答题和游戏的设计是为防止参与者患上痴呆症。当局在这方面有所警觉，是因为日本的囚犯和这个国家其余的人口一样正在变得更老迈。6月，政府决定修改刑法，将此类项目引入全国各地的监狱。

日本罪犯的老龄化可以在犯罪统计数据中体现出来。过去20年里，65岁以上的罪犯人数翻了一倍不止。如今老年罪犯比年轻罪犯更有可能再次犯罪而再次入狱。法务省估计，60岁以上服刑人员中约有14%有痴呆症状。

传统上，日本的监狱是高度惩罚性的。服刑人员需通过强制劳动来赎罪。一天中的大部分时间里都禁止交谈，只有在规定的时间才允许进行阅读等休闲活动。他们活得“像机器人一样”，前法务省官员、现为京都龙谷大学犯罪学家的浜井浩一说。

这种冰冷单调的生活会加速认知能力衰退。一些犯人在狱友身上看到这种前景逼近。“大多数年纪大过我的犯人都会一遍又一遍地说同样的话，”东京北边的栃木监狱里一名71岁的老人忧心忡忡地说，“我不想变得和他们一样。”

老年囚犯越来越多已经推动监狱变得更体谅了些——至少在私下里是这样。年长囚犯难以完成劳动任务，监狱减少了他们的工作量，还请来社工和护理人员辅助警卫。许多监狱都安装了扶手。有些还为咀嚼困难的囚犯

把食物捣成泥。“监狱开始变得更像疗养院了，政府官员开始质疑自己的现行方式。”浜井浩一说。

刑法修正案旨在把这种向更仁慈方式的转变写进明文法律，这是刑法自1907年颁布以来首次修法。监狱不再强制劳动，而是将提供教育活动以帮助罪犯重新融入社会，从而防止再次犯罪。但监狱系统缺乏财力人力来实施更密集细致的改造项目。专家担心服刑人员可能不理解这类活动的目的，强迫他们违背意愿参与可能反而有害。

政府一直在回避更深层次的改革。它没有考虑过通过放宽量刑指引以限制对老年人的监禁，也没有考虑特赦年长囚犯。日本老年人犯下的罪行大多数都是小偷小摸和店内顺手牵羊等轻罪，常常是在贫穷和孤独的驱使下犯罪。但屡犯轻罪仍可能在狱中度过多年。

“监狱能推出改造项目是件好事，但我不禁会想这些老人为什么会锒铛入狱呢？”东京的国学院大学的安田惠美说。她认为加强社会保障安全网会更有效。

当涉及到患痴呆症的服刑人员时，问题最为突显。日本法律禁止监禁有心理疾病的人，特别是如果他们不理解自己为何受惩的话。但这条规定很少被执行。因此，患痴呆症的囚犯人数很可能还会继续增加。专门帮助刑满释放人员重返社会的非营利组织母亲之家（Mother House）的创始人五十岚弘志说得好：“让痴呆症患者为自己的错误忏悔是没有用的。”■



Mr Smith goes to Silicon Valley

Why economists are flocking to Silicon Valley

And why big tech wants them

FOR MORE than a decade Facebook, now known as Meta, has awarded fellowships to promising graduate students working on cutting-edge research. The prize, which this year comes with up to two years' worth of university tuition and a \$42,000 stipend, has gone to computer scientists, engineers, physicists and statisticians. Now it has gone to an economist. "I was not expecting it," says Jaume Vives i Bastida, the lucky recipient working on a PhD at the Massachusetts Institute of Technology (MIT).

Silicon Valley is increasingly turning to economics for insights into how to solve business problems—from pricing and product development to strategy. Job-placement data from ten leading graduate programmes in economics shows that tech firms hired one in seven newly minted PhDs in 2022, up from less than one in 20 in 2018 (see chart). Amazon is the keenest recruiter. The e-emporium now has some 400 full-time economists on staff, several times as many as a typical research university. Uber is another big employer—last year the ride-hailing firm hired a fifth of Harvard University's graduating PhD class.

For the dismal scientists pay is a factor, says John List, a professor at the University of Chicago who has worked at Uber and Lyft. But tech companies also offer many of the benefits of a university career without the "publish or perish" culture. In the past, heading to the private sector often meant forgoing research completely. Now, explains Mr Vives, "Research can still be a big component of your job." Access to the companies' ample data is another selling point, says Steve Tadelis of the University of California, Berkeley, who spent two years at eBay, an online marketplace.

For big tech, meanwhile, economists offer skills that computer scientists and engineers often lack. They tend to have a good grasp of statistics, as well as a knack for understanding how incentives affect human behaviour. Most important, economists are adept at designing experiments to identify causal relationships between variables. Machine-learning engineers usually think in terms of prediction problems, notes one Ivy League grad who recently started a job in tech. Economists can nail down the causal parameters, he says.

An e-commerce firm may want to estimate the effect of next-day shipping on sales. A ride-hailing firm may wish to know which sets of incentives lure drivers back to the city centre after they are hailed by customers attending a big concert or sporting event. In two periods between 2015 and 2017 Mr List and colleagues at Lyft, Arizona State University and Boston University manipulated the prices and wait times for Lyft rides across 13 American cities to estimate the value of time. The study, which found that Lyft users value their time at about \$19 per hour, yielded a paper. It also led to a new feature on the Lyft app called “Wait & Save”, which lets riders opt for a longer wait time in exchange for a lower fare.

For all its recent recruitment success, Silicon Valley may have a harder time attracting the finest economists. In contrast to fields like artificial intelligence, “our best minds still stay in the academy,” observes Mr List. Maybe not for long. “I would like to be a professor, I would like to do research for a living,” says Mr Vives. “I can also do that at a tech company.”





斯密去硅谷

经济学家为何涌向硅谷

科技巨头为什么需要他们

十多年来，Facebook（已改名为Meta）一直在给做前沿课题的杰出研究生发放奖学金。今年的获奖者最高可得到两年的学费和4.2万美元的生活补贴。以往的获奖者一般都来自计算机科学、工程、物理和统计学专业。今年还有一位来自经济学专业。“我没想到能入选。”海梅·维韦斯·巴斯蒂达斯（Jaume Vives i Bastida）说。这名幸运儿目前在麻省理工学院攻读博士学位。

硅谷正在越来越多地转向经济学寻求洞见，以解决从定价、产品研发到战略的各种商业问题。排名前十的经济学研究生课程的就业数据显示，科技公司在2022年招聘了七分之一的博士应届毕业生，而在2018年还不到二十分之一（见图表）。亚马逊在这方面最为积极，这个电子商务集团现在拥有约400名全职经济学家，是一般的研究型大学的几倍。优步是另一个大雇主，这家网约车公司去年雇用了哈佛大学五分之一的经济学博士应届毕业生。

曾在优步和Lyft工作过的芝加哥大学教授约翰·利斯特（John List）说，对于研究这门沉闷科学的人来说，薪水是一个选择因素。但科技公司还能提供在大学里工作的诸多好处，却没有“不发表成果就出局”的文化。过去，选择在私营部门工作通常意味着完全放弃做研究。而现在，维韦斯解释说，“研究仍然可以是你工作中的重要组成部分”。能够接触到公司的大量数据是另一个卖点，加州大学伯克利分校的史蒂夫·塔德利斯（Steve Tadelis）表示。他曾在网购平台eBay工作过两年。

与此同时，对于大型科技公司而言，经济学家能带来计算机科学家和工程师通常缺乏的技能。他们往往熟练掌握统计学，并深谙激励措施如何影响人类行为。最重要的是，经济学家擅长设计实验来识别变量之间的因果关系。一名最近进入科技公司工作的常春藤盟校毕业生指出，机器学习工程

师通常从预测的角度思考问题，经济学家则能够确定因果参数。

一家电子商务公司可能想要估计次日发货对销售的影响。一家网约车公司可能想要知道，司机在送客户去参加大型音乐会或体育赛事后，能被什么类型的激励措施吸引而开回市中心。在2015年至2017年的两个时间段里，利斯特和他在Lyft、亚利桑那州立大学及波士顿大学的同事分析了Lyft在美国13个城市的乘车价格和等待时间，以估计时间价值。这项研究发现，Lyft用户对自己时间的估价约为每小时19美元。几位研究人员据此发表了一篇论文。这也促使Lyft的应用添加了一项新功能“Wait & Save”，乘客可以选择等待更长时间以节省车费。

尽管近几年来硅谷成功招募到了许多经济学人才，但要吸引到顶尖学者难度可能就大了。和人工智能等领域不同，“我们这个学科最优秀的头脑仍然还在大学里。”利斯特说。也许不久就会有变化了。“我想成为一名教授，想以研究为生，”维韦斯说，“这在科技公司也可以做到。”■



Wrinkle treatment

The ugly truth about young beauty brands' business model

They have a thing or two to learn from their mature rivals

PEOPLE LIKE to feel pretty. Over the past ten years Americans have spent more than \$500bn on beauty products. By 2024 the Chinese are expected to splurge more than \$100bn a year. In the past most of that would have gone to cosmetics conglomerates, such as L'Oréal and Estée Lauder, or to consumer-products giants like Unilever, selling every imaginable tincture to make everything from toenails to tresses more fetching. But in recent years fresh-faced newcomers, often more specialised and more digital, have entered the fray.

Now the upstarts are showing some wrinkles, as their business models are tested, investors lose patience with red ink and the incumbents up their game. The sales of Glossier, a hot American make-up firm most recently valued at \$1.8bn, fell by a quarter in 2021. The firm has laid off a third of its staff; its long-rumoured initial public offering (IPO) may be the subject of rumours for a while yet. Olaplex, a haircare firm that went public last September in a blockbuster IPO that valued it at over \$15bn, has since shed half its market capitalisation. Do the beauty challengers need to undergo their own metamorphosis?

The time-honoured way to market cosmetics was to pay millions to mostly white, mostly female top models and A-list stars who would appear in ads in glossy magazines and on billboards. Shifting the products, which were mostly made in-house, invariably involved a booth in a department store, a chemist's or a specialist retailer such as Sephora. The upstarts took a different tack. They outsourced production and enlisted social-media influencers of all hues and genders to promote their brands. This was meant to drive traffic to their online stalls, either on the firms' own

websites (an approach pioneered in the beauty business by Glossier) or on existing e-commerce platforms such as Amazon and Shopify in the West or JD.com and Alibaba's Tmall in China.

This approach has some big advantages. It affords the young companies access to data on shoppers and their preferences, says Lindsay Drucker Mann, chief financial officer of Il Makiage, another young American make-up darling. "If we sell through wholesale, we lose that information," she explains. Given how quickly make-up trends can sometimes change—just think of the sudden popularity of minimalist "clean-girl make-up"—such information is invaluable.

It also helps digitise beauty shopping, which as a deeply sensory experience has long resisted digitisation. Il Makiage is developing artificial-intelligence (AI) algorithms (sometimes by acquiring smaller AI firms) to help people choose the right foundation shade. Other brands use AI-assisted quizzes to help buyers pick the right product for them.

Techno-literacy may also make it easier to identify and target historically underserved market segments. Fenty Beauty caters to consumers who, like its founder, Rihanna, a pop icon, have a darker skin tone. In May the firm (which is part-owned by LVMH, a French luxury conglomerate) launched in eight African countries. Uoma Beauty, created by Sharon Chuter, an executive who quit the old cosmetics industry over its failure to be more "multicultural", offers 51 foundation shades. Uoma's sales grew sharply in 2021, relative to 2020. Pharrell Williams and Harry Styles, two other pop stars, have each launched gender-neutral beauty brands. Revenues of Byredo, which has been making gender-neutral perfumes since 2006, surged to \$141m last year, up from \$18m in 2020.

Increasingly, however, the upstarts' digital-first approach is showing its limits. Outsourcing, for example, allows the companies to remain light on

assets but can turn out to be costly at a time of supply-chain shocks of the sort that have rocked many sectors during the pandemic.

The influencer-based marketing strategy, meanwhile, has proved great at encouraging initial purchases but not necessarily repeat buys. Moreover, as the influencer economy has grown, so have the cheques demanded by the biggest names. They command as much as \$200,000 for a single social-media post. The fees may be bid up further as the incumbent giants increase their social-media exposure, which most of them are desperately trying to do in order to appeal to younger shoppers.

| *The ugly truth*

Bricks-and-mortar shops where many purchases, particularly of make-up, are spur-of-the-moment, remain critical to the beauty business. Most Americans still buy their cosmetics from Walmart. Chemists such as Walgreens and CVS also maintain a large market share. Around 90% of Uoma Beauty's sales are through retail partners, says Ms Chuter. In July Glossier stepped away from an exclusively direct-to-consumer approach by agreeing to sell some of its make-up through Sephora (which is owned by LVMH).

Big-beauty bosses are no doubt watching all this with glee. The upstarts' problems have highlighted the incumbents' abiding advantages: greater scale, sturdier supply chains and robust distribution networks. They also boast more resources to funnel into research and development (and not just chemistry labs: L'Oréal runs thriving tech incubators in America, France and Japan) or into acquisitions.

Even before the latest crunch some startups were becoming willing buy-out targets. In 2019 Drunk Elephant, an American skincare brand (founded in 2012), sold itself to Shiseido, a Japanese giant (founded in 1872). As more of the upstarts trip up and funding dries up amid a venture-capital winter,

they too may find that old beauty still has allure. ■



去皱疗程

关于年轻美妆品牌商业模式的丑陋事实

它们可以从成熟的对手身上学习一二

人人都爱漂亮。过去十年，美国人在美容产品上的总支出超过5000亿美元。到2024年，预计中国人每年会在这方面挥霍超过1000亿美元。在过去，这些支出大部分都会流向欧莱雅和雅诗兰黛这样的化妆品企业集团或者联合利华这样的消费品巨头。你能想得到的涂涂抹抹的东西它们都有得卖，让人从头发丝到脚趾甲都变得更动人。但是最近几年，新面孔也加入了战局，它们通常更专门化，也更数字化。

现在，这些年轻的面孔上也出现了几道褶子：它们的商业模式受到考验，投资者对亏损失去了耐心，而老牌企业也开始使出看家本领。2021年，美国热门化妆品公司Glossier的销售额下降了四分之一，近期估值18亿美元。该公司已裁员三分之一，传闻已久的IPO可能在一段时间内仍然只会是个传言。美发用品公司Olaplex去年9月重磅IPO，市值超过150亿美元，自那之后已缩水一半。美妆挑战者是否需要经历自身的蜕变？

营销化妆品的老法子是掏出数百万美元给主要是白人和女性的顶级模特和一线明星，请他们在时尚杂志上的广告中和广告牌上露脸。产品大多由公司自己生产，然后无一例外都会在百货公司、药店或丝芙兰等专门零售店里设个柜台来销售。新贵们采取了不同的策略。它们将生产外包，并招募各种肤色和性别的网红在社交媒体上推广它们的品牌。这是为了给它们的线上摊位引流，无论是在公司官网上（Glossier在美妆业务中开创了这种方法），还是在现有的电子商务平台上，如西方的亚马逊和Shopify，或中国的京东和阿里巴巴的天猫。

这种方法有一些大优势。它让年轻公司得以获取关于顾客及其偏好的数据，另一家年轻的美国彩妆新宠Il Makiage的首席财务官林赛·德鲁克·曼（Lindsay Drucker Mann）表示。“如果我们做批发销售，就会失去这些信息。”她解释道。鉴于美妆趋势有时转向之快——想想突然红起来的极简

风格的“清透女孩妆容”——这些信息极其宝贵。

它还有助于将美容购物数字化。这项深度感官上的体验一直都很抗拒数字化。Il Makiage正在开发人工智能（AI）算法（有时也通过收购较小的AI公司）来帮助人们选择合适的粉底色调。其他品牌使用AI辅助测验来帮助买家选择适合他们的产品。

熟悉技术也许也能让企业更易识别和瞄准以往服务不充分的细分市场。Fenty Beauty的目标客户是像它的创始人、流行偶像蕾哈娜那样肤色较深的人。5月，该公司（部分归法国奢侈品集团LVMH所有）进驻八个非洲国家。莎伦·丘特尔（Sharon Chuter）此前因不满传统化妆品行业未能增进“多元文化”而辞去高管职务，自创了Uoma Beauty品牌。该品牌提供51种粉底色号。2021年，Uoma的销售额较2020年大幅增长。另外两位流行明星法瑞尔·威廉姆斯（Pharrell Williams）和哈里·斯泰尔斯（Harry Styles）也各自推出了中性美妆品牌。自2006年起生产中性香水的柏芮朵（Byredo）的营收从2020年的1800万美元飙升至去年的1.41亿美元。

然而，这些新贵的数字优先策略正日益显现出局限性。例如，外包可以让公司保持轻资产模式，但是一旦遇到像疫情期间那样震荡了许多行业的供应链冲击，成本可能就会很高。

与此同时，事实证明基于网红的营销策略在鼓励初次购买上非常有效，但不一定能鼓励重复购买。此外，随着网红经济的增长，那些最大牌的网红开价也越来越高。他们在社交媒体上发布一条帖子的要价高达20万美元。随着大多数老牌巨头拼命增加自己的社交媒体曝光量以吸引年轻消费者，费用可能会进一步提高。

| 难看的事实

实体店对于美容行业来说仍然至关重要，因为这里发生的许多购买行为都是临时起意，尤其是买化妆品。大多数美国人仍然在沃尔玛购买化妆品。沃尔格林（Walgreens）和CVS等药店也保有很大的市场份额。丘特尔说，Uoma Beauty大约90%的销售是通过零售合作伙伴达成。7月，Glossier放

弃了完全直接面向消费者的方式，同意通过丝芙兰（由LVMH所有）销售部分化妆品。

大牌美妆公司的老板们无疑正兴高采烈地看着这一切。新贵们碰到的麻烦突显了老牌企业的持久优势：更大的规模、更稳固的供应链和强韧的分销网络。它们还拥有更多资源可用于研发（还不仅仅是化学实验室：欧莱雅在美国、法国和日本经营着蓬勃发展的科技孵化器）或收购。

甚至在近来的困境发生前，一些创业公司就已经很乐意成为收购的目标。2019年，成立于2012年的美国护肤品牌“醉象”（Drunk Elephant）把自己卖给了1872年问世的日本巨头资生堂。随着越来越多的新贵栽了跟头，加上资金也在风投寒冬中枯竭，它们可能也会发现上了年纪的美感。■



Free exchange

Richer societies mean fewer babies. Right?

A guide to the new economics of fertility

IN A SPEECH to the Vatican in January, Pope Francis made an observation fit for an economist. He argued that declining fertility rates might lead to a “demographic winter”. In every European country the total fertility rate, the expected number of children a woman will have in her lifetime, has now fallen below 2.1, the level needed to maintain a stable population without immigration. The same is true in many developing countries, including China and (as of this year) India. This, the pope warned, would weigh on the world’s economic health.

Economists have long considered such a slowdown inevitable. In the best-known model of fertility, popularised by Gary Becker, a Nobel-prizewinning economist, and others in the 1960s, there is a central role for the trade-off between the “quantity and quality” of children. As countries grow richer and the returns to education rise, it is expected that families will invest more in a smaller number of children. And as women’s working options expand, the opportunity cost of their time will grow, making the trade-off between family and career more difficult.

Fitting this theory, many places have already gone through a “demographic transition”, in which poor, high-fertility countries become rich, low-fertility ones. In some, the transition has been so dramatic that their populations have started to decline. The number of people in Japan has fallen by about 3m since peaking at 128m in 2008. Many demographers suspect China’s population is also falling, no matter what the country’s official figures claim.

Yet an emerging body of research suggests that fertility may go through

another shift at a later stage of development. A recent review of the literature by Matthias Doepke of Northwestern University and co-authors makes the case that, in rich countries, fertility may rise, or at least fall at a slower rate, if norms, policies and the market for child care make it easier for a woman to have children and a career. In countries with, say, supportive family policy or fathers who take on a greater share of child-care duties, one would expect working women to have more children than in the past.

One way to see if this is true is to compare fertility rates across countries with differing incomes and female labour-force participation. In 1980 countries in the OECD with higher female participation rates had lower rates of fertility. By 2000 that relationship had flipped: countries with higher rates of female labour-force participation had higher rates of fertility. Since then, the picture has muddied slightly. By 2019 the new relationship had weakened a little, and it looks less sturdy when considering GDP per person rather than labour-force participation

But when looked at within countries, the new pattern of fertility becomes clearer. A paper published in 2018 by Michael Bar of San Francisco State University and co-authors shows that in America the relationship between education and fertility, which used to be a downward-sloping trend, has turned into something of a reversed-tick mark. Women with advanced degrees have slightly more children than college graduates. A similar pattern holds when looking at income. The authors argue that the growing availability of child care has reduced the difficulty of the trade-off between family and work.

Governments are also trying to change the picture. Last year South Korea's fertility rate dropped to 0.81, a record low. In 2019, family-leave policy changed to allow parents with young children to take an additional year of reduced hours on top of an already generous year off work. The share of

South Korean parents who take leave has doubled in the past decade, from 12% to 24%. Meanwhile, Hungary has exempted mothers of four or more children from income taxes for life—a more controversial approach, especially since Viktor Orban, the country's prime minister, has justified it as a way to boost the population without allowing immigration to rise. A report published by the UN last year found that the share of countries with pro-natalist policies had grown from 20% in 2005 to 28% in 2019.

Not all interventions are equally effective. Work by Janna Bergsvik of Statistics Norway, an official research outfit, and colleagues, finds that, although some measures (including subsidised child care) make a difference, others (including parental leave) accomplish far less. Mr Doepke says the biggest boost to fertility occurs when interventions match the way that societies operate. The provision of child care will make little difference if social norms push women to stay at home to look after children. But in Denmark, where fathers take on more child-care responsibilities than in other rich countries, the provision of state-subsidised care for children made a big difference. The country's fertility rate rose from 1.38 in 1983 to 1.72 in 2021.

| *Flush of youth*

There is a lot riding on the new fertility switch lasting. The share of the population in the OECD aged 65 and over is expected to have passed 50% by 2050, about 20 points higher than today. As rich countries grow old, there will be greater demand for carers, which will make it more expensive to hire child care. Without a productivity revolution, perhaps featuring robot nannies, child care will remain a privilege of the rich in places without state-funded provision. It is also unclear if norms that make the family-career trade-off easier will continue to spread.

Yet the worse the problem becomes, the harder governments will work to combat it. And as they experiment, evidence will build about which

responses are the most effective. The covid-19 pandemic may also end up helping. It delayed many families' decisions about whether to have children, but in time it may turn out to have had a more positive impact. The rise of working-from-home should make working with children easier. In his speech the pope lamented those people who chose to look after pets instead of children. Maybe that trade-off will lessen, too. ■



自由交流

国家愈富生育率愈低。对吗？

新生育经济学指南

今年1月，教皇方济各在梵蒂冈的演讲中发表了一个观点，俨如一名经济学家。他说，生育率下降可能会导致“人口寒冬”。现在每个欧洲国家的总生育率（一名妇女一生中预期生育孩子的数量）均已跌破2.1——这个数字是在不需要外来移民的情况下使人口持平的最低水平。许多发展中国家也一样，包括中国和（从今年开始的）印度。教皇警告称，这将拖累世界的健康发展。

经济学家早就认为这种下滑无可避免。在诺贝尔经济学奖得主加里·贝克尔（Gary Becker）等人于1960年代提出的广为人知的生育模型中，人们对生育孩子的“数量和质量”的权衡发挥着关键作用。随着国家变得更富裕，教育的回报上升，可以想见家庭会少生孩子，但为他们投入更多资源。而随着女性就业的选择越来越多，她们的时间的机会成本会增加，令她们更难平衡家庭和事业。

与这套理论相印证的是，许多地方已经经历了“人口转型”，从贫穷的高生育率国家变成了富裕的低生育率国家。一些国家的转变异常剧烈，人口数量甚至已经开始下降。日本人口在2008年达到1.28亿的峰值，自那以来已经减少了约300万。许多人口学家猜测中国的人口也在减少，无论官方公布的数据如何。

然而，一系列新研究指出，在经济发展更往后的阶段，生育率可能会经历又一次转变。西北大学的马提亚斯·德普克（Matthias Doepke）等人在近期发表的一则文献综述中指出，在富裕国家，如果习俗、政策和市场让女性能够更容易兼顾生育和就业，那么生育率可能又会上升，或者至少下滑得更慢。例如，在具有支持性家庭政策或父亲承担更多育儿责任的国家，可以预期职业女性将比过去生育更多子女。

要检验这个结论是否正确，一种方法是比较不同收入水平和女性劳动参与率的国家的生育率。1980年，在经合组织中，女性劳动参与率较高的国家的生育率较低。到了2000年，这种关联发生了逆转：女性劳动参与率高的国家生育率也更高。自那之后，情况变得有点模糊不清。到2019年，这种新关联略有弱化，而如果考虑人均GDP而不是劳动参与率的话，关联度就更不确切了。

但若是从国家内部观察，新的生育模式就显得更清晰了。旧金山州立大学的迈克尔·巴尔（Michael Bar）等人在2018年发表的论文显示，美国的受教育程度和生育率之间的关系以前是一条向下倾斜的趋势线，但现在已经变成类似于一个勾号左右翻转。硕博学历的女性生育的孩子略多于本专科学历者。从收入维度看也呈现出类似的模式。作者认为，育儿服务日益发达减轻了平衡家庭和工作的难度。

各国政府也在试图改变局面。去年，韩国的生育率降至0.81，创历史新低。2019年，政府调整了生育假政策，允许幼儿的父母在本已慷慨的一年育儿假的基础上，再享受一整年减少工作时长的待遇。在过去十年里，韩国父母休育儿假的比例翻了一番，从12%增加到24%。与此同时，匈牙利对四个或以上孩子的母亲终身免征个人所得税。这是一项更具争议的举措，尤其是考虑到该国总理维克托·欧尔班（Viktor Orbán）给出的理由是要在不允许增加移民的情况下提振人口。联合国去年发布的一份报告发现，实行鼓励生育政策的国家比例从2005年的20%增长到2019年的28%。

并非所有干预措施都一样有效。官方研究机构挪威统计局（Statistics Norway）的詹娜·伯格斯维克（Janna Bergsvik）等人的研究发现，尽管一些措施（包括育儿补贴）发挥了作用，有些措施（包括育儿假）收效甚微。德普克表示，当干预措施与社会运行模式相匹配时，才能最大程度地提高生育率。如果社会常情要求女性留在家中照顾孩子，提供育儿服务也起不到什么作用。但是在丹麦，父亲承担的育儿责任比其他富裕国家的男性更多，由国家提供补贴的育儿服务就效果显著。该国生育率从1983年的1.38上升到2021年的1.72。

| 生生不息

生育率的新转折能否持续下去事关重大。预计到2050年，经合组织成员国中65岁及以上的人口比例将超过50%，比现在高约20个百分点。随着发达国家老龄化，对照护人员的需求将会增加，进一步推高聘请婴幼儿照护的费用。除非发生一场生产力革命——也许是由机器人保姆承担重任，否则在没有国家补贴的地区，育儿服务仍将为富人专享。有利于平衡家庭与事业的社会习俗是否会继续传播扩大，同样不清楚。

不过，问题变得越严重，政府就越会努力去解决它。而随着它们不断尝试，会有更多证据显示哪些措施最有成效。新冠疫情可能最终也会有所助力。疫情让许多家庭推迟做出生育方面的决定，但随着时间推移，它最终可能会显现更积极的影响。随着居家办公兴起，兼顾工作和孩子应该会变得更容易。教皇在讲话中哀叹有些人宁愿养宠物也不养孩子。也许这种取舍也会减少。■



Peer review

An influential academic safeguard is distorted by status bias

To those that have, more shall be given

WHEN, IN 1905, the then-unknown patent clerk Albert Einstein sent his revolutionary ideas on special relativity, the photoelectric effect, Brownian motion and a few other topics to the German journal *Annalen der Physik*, its editors were happy to publish them. Submissions were rare and therefore rarely rejected—unless the text was clearly bonkers.

Things are different now. Most top academic journals use a system of peer review, which asks independent experts in the same field to assess papers before they are accepted. Reviewers are meant to check the methods, analysis and conclusions and, crucially, whether the work meets the required standards for publication.

No scientist would claim that peer review is perfect. There are plenty of famous cases of ground-breaking papers being rejected after flawed advice from reviewers, while seldom a week goes by without one field or another rounding on a shoddy piece of work on social media and asking how on Earth it passed peer review. Many researchers describe the review process by borrowing Winston Churchill's quip about democracy: it's the worst system except for all the others.

A new study of the peer review process reveals a novel and depressing, if not totally surprising, fault. It indicates that a modern-day Albert Einstein, or any researcher with a good idea but without an already-stellar reputation, might struggle to get their foot in the door. Status bias means the name of the individual on the paper can matter as much as the findings when it comes to what gets published, suggests the study, which was released last month as a working paper on the SSRN repository.

Researchers have suspected for a long time that work from established senior figures often gets an easier ride in peer review and is more likely to be accepted and published. It is an example of the so-called Matthew effect of accumulated advantage, that eminent people get disproportionate credit for work—named after the biblical parable of the talents in the Gospel of Matthew, which states that “to everyone who has will more be given”.

In the new study, researchers at the University of Innsbruck, in Austria, collaborated with Vernon Smith, an experimental economist at Chapman University, in California, and a winner of the Nobel Memorial Prize in Economic Sciences. Dr Smith had just completed a project with Sabiou Inoua, a colleague at Chapman University who at the time was a PhD student. The duo had written a paper on financial and market data that was ready to submit to an academic journal.

The team from Innsbruck had a devious plan—use the name of either Dr Smith or Mr Inoua as the paper’s author and send it to peer reviewers to see how they judged the quality of the work. Editors at the *Journal of Behavioural and Experimental Finance*, the journal to which the pair submitted their manuscript, were admirably ready to play along.

They first asked more than 3,300 potential reviewers if they would be willing to take the time to assess the manuscript, based on a short abstract emailed to them that listed one of the two authors’ names, or omitted the names entirely. In this scenario, including Dr Smith’s name saw the acceptance rate jump—almost 40% agreed to review when he was the author compared with closer to 30% when the author was Mr Inoua or not listed.

Those who agreed were sent a full manuscript to review, with the same pattern of names, and more than 500 reviewers submitted reports. When they thought it was Mr Inoua’s work alone, 65% of reviewers voted to reject

it. That is almost three times as many as the 23% of reviewers who rejected the same paper when it carried only Dr Smith's name.

But it was also a significantly higher rejection rate than the 48% who spurned the paper when it was completely anonymous. Not only did Dr Smith's eminence boost his numbers, but the newbie status of Mr Inoua counted against him.

Does the pernicious impact of status bias seep beyond the pages of this particular journal and this particular field? Juergen Huber, one of the Innsbruck team, is certain that it does. Every discipline from chemistry and physics to medicine and genetics has its own superstars, he says, while some results indicate that top institutions like Harvard University also get a status boost in peer review.

One option to deal with the bias is to remove all names from all manuscripts under review. But Dr Huber points out this is increasingly difficult with the rise of preprints and working papers published online before they are formally submitted to a journal. Any reviewer of an anonymous manuscript could simply search for its tell-tale online trail.

The story has an interesting coda. Mr Inoua and Dr Smith's bold willingness to test the limits of peer review has not come without cost. The *Journal of Behavioural and Experimental Finance* is yet to publish their paper. It is waiting for the duo to respond to the reviewers' comments—all 500 of them. ■



同行评议

一道有影响力的学术保障被地位偏见扭曲

凡有的，还要加给他更多

一九〇五年，阿尔伯特·爱因斯坦还是一位名不见经传的专利文员，他把自己关于狭义相对论、光电效应、布朗运动和其他一些革命性理论的文章发给了德国的《物理学年鉴》（Annalen der Physik）期刊，编辑很痛快地发表了这些文章。当时投稿数量极少，所以也极少被拒，除非明显不着调。

现在的情况就不一样了。大多数顶级学术期刊都使用同行评议制度，要求同一领域的独立专家在稿件被录用之前审稿。审稿人需要审查研究方法、分析过程和结论，最重要的是要看论文是否符合发表标准。

没有科学家会说同行评议制度是完美的。开创性论文因审稿人的错误建议而被拒的知名案例不在少数，而在社交媒体上，几乎每周都会有某个领域对一篇蹩脚论文狂轰乱炸，质问它到底是如何通过同行评议的。许多研究人员都借用丘吉尔对民主的调侃来描述评议制度：这是最坏的制度，所有其他制度除外。

一项关于同行评议过程的新研究揭示了它的一个新鲜的令人沮丧的缺陷，甚至可能有点出乎意料。它指出，今天的“爱因斯坦”或任何有创新想法但没有名气的研究人员可能都很难跨过这道门槛。这项上月在SSRN资料库发布了工作论文的研究发现，在决定哪些论文能够发表的时候，地位偏见意味着论文署名可能和研究结果一样重要。

研究人员长久以来都怀疑，如果一个人资历深有名气，他的论文通常会更容易通过同行评议，更有可能被录用发表。这是关于所谓累积优势的马太效应的一个例子，即已经功成名就的人在工作中会得到更多认可，这个效应的名字来自《马太福音》（Gospel of Matthew）中按才干受责任的圣经寓言，里面写道“凡有的，还要加给他”。

在这项新研究中，奥地利的因斯布鲁克大学（University of Innsbruck）的研究人员与加州的查普曼大学（Chapman University）的实验经济学家、诺贝尔经济学奖获得者弗农·史密斯（Vernon Smith）合作。史密斯刚刚与查普曼大学的同事萨比乌·伊努瓦（Sabiou Inoua）完成了一个项目，后者在研究期间还是一名在读博士生。两人合著了一篇关于金融和市场数据的论文，准备向学术期刊投稿。

因斯布鲁克的课题组耍了一个花招，分别只用史密斯或伊努瓦的名字为论文署名，再提交供同行评议，看他们会如何判断论文的质量。两人投稿的期刊《行为与实验金融学期刊》（Journal of Behavioural and Experimental Finance）的编辑全力配合。

他们首先把论文摘要通过电子邮件发送给3300多名潜在审稿人，问他们是否愿意花时间审阅文稿，摘要只列出了二人中一人的名字，或者完全省略了姓名。结果，看到署名史密斯的审稿人同意审稿的比例很高，达到近40%，而当署名作者是伊努瓦或未标出作者姓名时，有近30%的人同意审稿。

同意审稿的人接着会收到完整的稿件，署名方式与第一步相同，超过500名审稿人提交了评议报告。以为伊努瓦是唯一作者的审稿人有65%建议拒绝录用这篇论文，而以为史密斯是唯一作者的审稿人建议拒稿的比例为23%，前者是后者的近三倍。

但相比完全匿名的稿件48%的拒稿率，65%的比例也还是高出很多。不单单是史密斯的声望提高了他的通过率，伊努瓦的新人身份也给他造成了不利影响。

地位偏见的有害影响是否并不局限于这一本期刊和这一个领域呢？因斯布鲁克课题组的成员之一于尔根·休伯（Juergen Huber）确信是如此。他说，从化学和物理学到医学和遗传学，每个学科都有自己的超级明星，一些结果也表明，像哈佛大学这样的顶尖机构也在同行评议中有地位加分。

想要克服偏见，一个选择是所有送审稿件都不署名。但休伯指出，随着在

正式向期刊投稿之前在线发表的预印本和工作论文的兴起，这变得越来越难有效果。任何匿名稿件的审稿人只要搜索一下文章在网络上的踪迹就知道出自谁手了。

这个故事有一个有趣的结尾。伊努瓦和史密斯如此大胆地测试同行评议的局限性可不是没有代价的。《行为与实验金融学期刊》还没有发表他们的论文。它还在等待二人逐一回复审稿人的意见——500多条一条都不能漏。■



Additive manufacturing

A gooey way to 3D print plastics

Use high viscosity resins and alternate layers

THE USE OF plastics for mass production traces its roots to the 1860s and John Wesley Hyatt, a printer from Albany, New York. Hyatt was responding to the offer of a \$10,000 reward to anyone who could come up with an alternative way of making billiard balls—which were, in those days, carved out of ivory, a commodity becoming in short supply. His solution was to form them by pumping a molten synthetic plastic called celluloid into a mould.

Although Hyatt appears never to have received the prize, the process he invented, injection moulding, became the way in which most plastic items are made. At least they were until the emergence in the early 1980s of additive manufacturing, popularly known as 3D printing. Machines that can print things in plastic have become ever more capable, turning out objects ranging from toys to medical implants, and components for cars, drones and aircraft.

Another advance is now in the making. BCN3D Technologies, a Spanish producer of 3D printers, has developed a new form of plastic printing which it calls viscous lithography manufacturing (VLM). From an initial 500 firms said to be keen to try the idea out, BCN3D has whittled the number down to 20 large manufacturers from industries such as carmaking, electronics and engineering. These are now working on potential applications at the company's base in Barcelona. The plan is that early next year they will install VLM machines at their factories around the world before the printers go on general sale in 2024.

3D printers can make plastic objects in several ways. One widely used

technique involves an extrusion head tracing lines of molten polymer onto a so-called build plate. Once the first layer is done, the plate moves down a tad, a second layer is added on top of the first, and so on. More recent machines project a pattern of ultraviolet (UV) light into a vat of photosensitive liquid resin to cure and solidify the layers required to create an object. A build plate then steadily pulls the object out of the vat.

It is this second approach on which VLM is building, as it were—though the process works more like an upside-down screen printer. The machine consists of a pair of liquid-resin reservoirs, one each on either side of a build plate. Above all of these sits a transparent screen that shuttles back and forth. When one side of the screen is above a reservoir a roller coats its underside with a thin film of resin. At the same time, the adjacent side of the screen, having already been coated at the second reservoir, is positioned over the build plate.

The plate then rises to make contact with the resin film on this part of the screen. A pattern of UV light from an LCD is projected through the screen from above to cure the resin in particular areas, allowing a complete layer to be solidified in one shot. As the build plate is lowered it peels this layer away. The peeled part of the screen then slides back to its reservoir, where any unused resin is recovered to be reused, and the newly coated other side of the screen is subjected to the same process of UV curing and peeling. And so the process continues, back and forth, until the object is complete.

One benefit of printing in resins is that they produce finely detailed, high-quality plastic parts. A drawback is that they can be brittle. It is possible to mix additional materials into resins, to improve strength, for instance, or to add flexibility. But, a bit like adding more ingredients to a cake, this thickens the mixture, which can make the resin difficult to print. The VLM process, however, can cope with this because, as Eric Pallarés, the company's chief technology officer, explains, it is designed from the get-go

to use much thicker resins.

The two reservoirs can also be filled with different resins, allowing more complex construction. This would permit, say, a soft-touch surface to be added to a rigid switch. Strength could be achieved by mixing in filler materials made from the shredded remains of previously printed objects. Alternatively, a soluble material could be printed, to support delicate structures during construction, and these supports could then be washed away. At the moment, support structures often have to be added and removed laboriously, by hand.

| *Ejecting injection*

So far, VLM is proving roughly ten times faster at making things than most other forms of plastic printing, claims Mr Pallarés. And the size of objects which can be produced is limited only by the size of the LCD used to project the image of each layer. As with most 3D printers, including those which use different processes to print metals, VLM is capable of making complex structures that are difficult or impossible to fabricate with conventional production methods such as injection moulding.

Injection moulding is also uneconomic when it comes to producing low volumes, because the precision-engineered moulds it requires can cost several hundred thousand dollars to make. That does not matter if those moulds are being used to make huge numbers of things, but for small batches the cost is prohibitive.

Additive manufacturing, however, thrives on low volumes of production, because 3D printers run on software, which is easier and cheaper to change than physical moulds. When it comes to making millions of cheap and cheerful plastic things, Hyatt's invention is likely to retain its edge for a while. For more bespoke items, additive manufacturing is just getting better and better. ■



增材制造

高粘度3D打印

使用高粘度树脂和交替材料层【新知】

大规模生产塑料制品可以追溯到1860年代的约翰·韦斯利·海厄特（John Wesley Hyatt），他是纽约州奥尔巴尼（Albany）的一名印刷工人。当时，有人悬赏一万美元寻求制造台球的新方法，海厄特参与了竞逐。在那个年代，台球由象牙雕刻而成，而象牙越来越供不应求。他的解决方案是将一种叫做赛璐珞的合成塑料熔化并注入模具，然后制成台球。

虽然海厄特最终似乎并没有拿到那笔奖金，但他发明的注塑成型工艺成了大多数塑料制品的制造方法。这种工艺一路延续，直到1980年代早期出现了增材制造——俗称3D打印。能用塑料打印物件的机器变得越来越能干，可打印的物品多种多样，从玩具到医疗植入物，再到汽车、无人机和飞机的部件。

现在，另一项进步正在成形。西班牙3D打印机制造商BCN3D Technologies开发了一种新的塑料打印技术，称为粘性光刻制造（VLM）。据称最初有500家公司有意尝试这个创意，BCN3D筛选出了20家大型制造商，来自汽车制造、电子和工程等行业。目前，这些企业正在该公司的巴塞罗那基地研究这项技术的潜在应用。它们计划明年初开始在世界各地的工厂安装VLM打印机。这种打印机将在2024年上市发售。

3D打印机可以采用多种方法制造塑料物件。一种广泛使用的工艺是通过喷嘴将熔融聚合物的细丝喷到所谓的打印平台上。喷完第一层后，平台略微下移，在第一层之上再喷第二层，以此类推。更新型的机器将紫外光（UV）图案投射到一桶光敏液体树脂中，一层层地硬化和固化出要制造的物件。然后打印平台将物件稳稳地从桶中拉出来。

VLM技术可说是基于第二种方法——但其工作过程更像是一台倒置的丝网印刷机。这台机器由一对液体树脂储存盒组成，分别位于打印平台的两

侧。在它们的上方是一块来回移动的透明隔屏。当隔屏的一侧滑到一个储存盒上方时，一个滚筒会在其底面涂上一层薄薄的树脂。此时，隔屏的另一侧此前已经由另一个储存盒完成涂覆，正停留在打印平台的上方。

然后平台上升，与这部分隔屏上的树脂薄膜接触。一台液晶显示屏（LCD）投射出紫外光图案，从上方穿透隔屏，对特定区域的树脂进行硬化，一次照射便可固化整层树脂。然后平台下降，把固化层从薄膜中剥离。完成剥离的隔屏一侧再次滑回储存盒上方，未使用的树脂被回收再利用，而隔屏的另一侧又已再次涂覆完毕，现在接受同样的紫外光固化和剥离过程。就这样，整个过程持续进行，往复不断，直至物件完成。

用树脂打印的好处之一是可以生产出精细、高质量的塑料件。但缺点是产品可能比较脆。在树脂中添加其他材料以改善性能是可行的，比如提高强度或柔韧性等。但是，这有点像给蛋糕添加更多原料，会使混合物变稠，可能导致树脂难以打印。不过VLM工艺可以解决这个问题，正如公司首席技术官埃里克·帕拉雷斯（Eric Pallarés）解释的那样，它从一开始就是为了使用粘稠得多的树脂而设计的。

两个储存盒也可以分别盛装不同的树脂，从而实现更复杂的构建，例如可以在一个坚硬的开关上添加一个柔软触感的表面。之前打印物件的碎屑可以制成填充料，混入树脂后可以实现更高的强度。另外还可以使用可溶性材料打印，在构建过程中为精细的结构提供支撑，最后将这些支撑部分洗掉即可。目前，往往需要费力的手工操作才能添加和移除支撑结构。

| 取代注塑

帕拉雷斯声称，到目前为止，VLM的制造速度比大多数其他形式的塑料打印快十倍左右。可以打印的物体大小仅受限于投影每一层图像的LCD的尺寸。与大多数3D打印机一样，包括那些使用不同工艺的金属打印机，VLM能够制造出传统生产方法（如注塑成型）难以或者无法实现的复杂结构。

在小批量生产时，注塑成型也不划算，因为它需要精密设计的模具，造价可能高达数十万美元。如果用这些模具生产极大数量的商品还好，是小批

量的话，这样的成本令人望而却步。

而增材制造却在小批量生产中大展拳脚，因为3D打印机依靠软件运行，而更换软件比更换实体模具更简单也更便宜。要制造数以百万计的价廉物美的塑料制品，海厄特的发明很可能仍将在一段时间内保有优势。而对于更加定制化的物品，增材制造正变得越来越好用。 ■



Camouflage

The complex arms race between predator and prey

A new study attempts to quantify how well disguise works in nature

CAMOUFLAGE IS THE by-product of an evolutionary arms race between one group—the predators—that want to eat another group—the prey. Prey seek to survive by tricking the perceptual and cognitive systems of the predators. And predators look to eat by breaking through the camouflage of the prey.

To put it all more formally, predators need to maximise their perception of signal (their proposed meal) from the noise (the general environment); the goal of prey is to minimise that same signal-to-noise ratio. While the physical manifestations of camouflage might be diverse, they function in one of three ways: to impair detection, to impair identification or to redirect attack. Methods that impair detection trick the perceptual system of a predator into believing that the prey is simply not there. Octopuses change colour to match their backgrounds, for example. The tasselled wobbegong shark (pictured) conceals its shadow against the ocean floor by being incredibly wide and flat. The white bellies of penguins match the sky, and their black coats, the depths of the ocean, in what is known as “countershading”. The arctic fox sports white fur in the winter and brown or grey in the summer. The comb jelly is transparent. Deep-sea fish are very black.

Often, the evolution of this kind of camouflage is detectable on a shorter timescale too—the populations of dark-coloured peppered moths grew in England, for example, as sooty pollution increased in the 19th century during the Industrial Revolution. Correspondingly, the population of light-coloured moths rose when pollution levels fell.

Impairing identification tricks the cognitive system of predators into thinking that whatever it is looking at is uninteresting (and definitely not food-like). The dead leaf butterfly, for example, looks like a dead leaf. Predators themselves use this too—leopards have high-contrast disruptive patterning which allows them to better blend into shadowy bushes and tall grass to avoid detection by their prey.

Redirecting attention is a way to try to reduce the lethality of attack, thereby increasing the chances of survival. The eyespots on the wings of a peacock butterfly, for example, divert attention towards less important regions of the insect's body. Zebras' stripes deploy a technique called "motion dazzle", which disrupts a predator's ability to work out which direction the animals are moving in.

How good are any of these camouflage tactics? A study published this week in *Proceedings of the Royal Society B* tries to find out. João Vitor de Alcantara Viana and colleagues from the State University of Campinas, in Brazil, compiled results from 84 studies on camouflage. They found that camouflage increased the amount of time a predator spent searching by over 60%, and it decreased the number of prey that were detected and attacked by around 25%.

| *Peek-a-boo!*

Masquerade (the dead leaf butterfly, for example) was the most effective technique, nearly quadrupling the time predators spent searching. Eyespots on butterfly wings seemingly provided no benefits in terms of hiding time from predators, but Mr Alcantara noted that this was not surprising since that tactic is not meant to interfere with detection, but rather to reduce the lethality of an attack.

Camouflage need not be visual. Bats, for example, perceive the world through sound. Some of the moths they predate have therefore evolved a

“stealth coat”—made of tiny hairs and a layer of scales—that reduces their detectability through echolocation. Marc Holderied, a biologist at the University of Bristol, wanted to know how good the moths were at hiding from bats so he shaved off their hairs and then sent sound waves towards them, mimicking how bats might echolocate to find their prey. The moths’ one-and-a-half-millimetre layer of fur, it turned out, reduced their detectability by just over 40%.

In addition to the fur, moths also have a thin layer of scales, tens to hundreds of thousands of them, on each wing. The scales each respond to specific frequencies of sound waves and when a bat’s echolocation signals hits the moth’s wings, the scales start to vibrate. The acoustic energy from the echolocation is thus absorbed.

Dr Holderied and his colleagues tested how well the scales worked and found that they were just as good at absorbing sound as the fur—they absorbed as much as 87% of the incoming sound energy, but at only one tenth of the fur’s thickness. In terms of their ability to absorb sounds, Dr Holderied says the moth’s scales outperform (and are much thinner than) any human-designed soundproofing used in homes and offices.

Camouflage not only provides a backdoor into glimpsing the magnificently diverse sensory worlds of animals, it has also inspired intriguing applications for people. Artists and anti-technology activists have invented make-up techniques, for example, known as “computer vision dazzle” that take their cues from natural camouflage and work by drawing high-contrast contours and colourful shapes on human faces so that they can evade detection by computer facial recognition. And Dr Holderied’s team has been taking inspiration from the miraculously sound-absorbing properties of moths to design wallpaper that can reduce the noise of road traffic for the occupants of a building. Though evolved in nature, camouflage can be useful in modern city life too. ■



伪装

捕食者和猎物之间复杂的军备竞赛

一项新研究试图量化伪装在自然界中的效用

伪装是在一个群体——捕食者——和它们想要吃掉的另一个群体——猎物——之间的进化军备竞赛的副产品。猎物通过欺骗捕食者的感知和认知系统来寻求生存。捕食者通过识破猎物的伪装来觅食。

说得更正规些，相对于噪声（一般环境），捕食者需要把它们对信号（它们的进食目标）的感知最大化；猎物的目标是把这个信噪比最小化。虽然伪装可能有五花八门的呈现方式，但它们以三种方式之一发挥作用：干扰发现、干扰识别、转移攻击。能干扰发现的方法会让捕食者的感知系统相信眼前根本没有猎物。例如，章鱼会改变颜色融入周遭环境。须鲨（见图）长得又宽又扁，这样它们趴在海底时就会盖住自己的阴影。企鹅的白色肚子与天空的颜色一样，黑色的后背又与深海的颜色一致，也就是所谓的“反影伪装”。北极狐在冬季体毛为白色，到夏季变成棕色或灰色。栉水母是透明的。深海鱼长得乌漆墨黑。

这类伪装的进化往往在较短的时间跨度里就能看到。例如，19世纪工业革命期间煤烟污染增加，英国的深色桦尺蛾的种群也增加了。相应地，当污染水平下降时，浅色飞蛾的数量增加。

干扰识别指的是欺骗捕食者的认知系统，让它认为自己正在看的东西索然无趣（而且绝对不像食物）。例如，枯叶蝶看上去就像一片枯叶。捕食者自己也使用这种方法——豹子长有高对比度的混乱的花纹，这使它们能更好地与斑驳的灌木丛和高草丛融为一体，不被猎物察觉。

转移注意力这种方法则试图降低攻击的杀伤力，从而增加存活机会。例如，孔雀蛱蝶翅膀上的眼纹会把注意力转移到它身体上较不重要的区域。斑马的条纹用到了一种名为“运动眩”的方法，破坏了捕食者确定它们移动方向的能力。

这些伪装战术多有用呢？近期发表在《英国皇家学会学报B》上的一项研究试图找出答案。巴西的坎皮纳斯州立大学（State University of Campinas）的若昂·维托尔·德阿尔坎塔拉·维亚纳（João Vitor de Alcantara Viana）及其同事汇总了84项有关伪装的研究结果。他们发现，伪装令捕食者花在搜寻猎物上的时间增加了60%以上，令被发现和攻击的猎物数量减少了约25%。

| 躲猫猫啦！

乔装（例如枯叶蝶）是最有效的战术，几乎令捕食者的觅食时间增加了三倍。蝴蝶翅膀上的眼纹对于拖延被发现似乎没有帮助，但德阿尔坎塔拉指出这并不奇怪，因为这里的策略并不是为了干扰被发现，而是为了降低攻击的致命性。

伪装不一定是视觉上的。例如，蝙蝠通过声音感知世界。因此，它们捕食的一些飞蛾已经进化出一种“隐身外套”，由细小的毛发和一层鳞片组成，降低了自己被回声定位发现的机会。布里斯托大学（University of Bristol）的生物学家马克·霍尔德里德（Marc Holderied）想知道这些飞蛾在躲避蝙蝠方面的表现如何，于是剃掉了它们的毛发，而后向它们发送声波——模仿蝙蝠如何用回声定位找到猎物。结果发现，这些飞蛾1.5毫米厚的毛皮把它们被探测到的几率降低了40%多一点。

除了毛发之外，飞蛾的每只翅膀上都还有一层薄薄的鳞片，总数达几万到几十万不等。每个鳞片都会响应特定频率的声波，当蝙蝠的回声定位信号击中飞蛾的翅膀时，鳞片开始振动。来自回声定位的声能就这样被吸收。

霍尔德里德博士和他的同事测试了这些鳞片的效用，发现它们的吸音能力和毛皮一样好——它们吸收了高达87%的入射声能，但厚度仅为毛皮的十分之一。霍尔德里德说，就它们吸收声音的能力而言，飞蛾的鳞片要优于任何人工设计的在家庭和办公室中使用的隔音材料，而且要薄得多。

伪装策略不仅让人得以一窥动物极为丰富多样的感官世界，还启发了供人

使用的有趣应用。例如，艺术家和反科技活动人士发明了名为“计算机视觉炫目”的化妆术，借鉴自然界中的伪装，在人脸上绘制高对比度的轮廓和丰富多彩的形状，帮助他们躲过计算机人脸识别。而霍尔德里德的团队从飞蛾神奇的吸音能力中汲取灵感，设计可为楼内人群降低道路交通噪音的墙纸。虽是在自然界中进化而来，伪装在现代城市生活中也可能很有用。 ■



House on fire

China's property crisis hasn't gone away: it is getting worse

Officials may have little choice but to bail out the industry

WEEKS AHEAD of the Chinese Communist Party's 20th congress, at which Xi Jinping, the country's president, is expected to secure a third term as party leader, an already big problem is becoming even more alarming. More than two-thirds of urban households' wealth is tied up in property and the industry underpins a fifth of GDP. The housing market is slumping into a deepening hole, dragging the economy down and even causing small outbreaks of social unrest.

The frenetic pace of house building used to be emblematic of China's rise. Now confidence in the model has collapsed. Buyers are dropping out, borrowers are on mortgage strikes and developers face a liquidity squeeze. In July the value of new home sales fell by 29% compared with a year earlier. Country Garden, China's biggest developer, has reported that its profits have collapsed and says the market "has slid rapidly into deep depression".

Two years ago, in an attempt to tame the property monster, the government imposed limits on borrowing by developers, known as the "three red lines". The reforms carried the imprimatur of Mr Xi, who insisted that "Housing is for living in, not for speculation." The original idea was that tougher rules would lead property firms to be more restrained and deter speculative buyers, allowing house building to slow to a sensible pace.

Things started to go wrong last year with the default of Evergrande, a giant developer. A year later Mr Xi's strategy lies in tatters as activity has faltered. The crisis is now a political, as well as economic, problem. In parts of the country, distress is turning into defiance. Mortgage-holders have banded

together, threatening to stop repaying their loans if work does not resume on long-overdue homes.

Part of the problem is Mr Xi's fixation with zero covid. In trying to suppress outbreaks with lockdowns—Chengdu, with a population of 21m, is the latest mega-city to be put through the wringer—the state has stomped on confidence.

Another part is that the government's original plan did not resolve the conflicts between growth and financial prudence, and between citizens' needs and the incentives of crony officials and developers. The three red lines have deprived property firms of the cash they need to finish building flats that they had sold in advance. Delays in finishing past projects have in turn made it harder to sell new ones to disgusted buyers. Weak sales have worsened the cash crunch. And the absence of a coherent bankruptcy process has left firms like Evergrande in limbo.

The central government has been trying quick fixes. It has cut interest rates and allowed local governments to ease restrictions on who can buy property and how. It has also encouraged local bail-outs of unfinished construction projects. But local authorities lack the resources to ease the distress, not least because property downturns hurt their revenues from land sales.

China's property market needs to be redesigned. Local governments need other sources of revenue to lessen their dependence on selling land. The receipt of money in advance for unbuilt properties must be better policed, to prevent fraud and collapses. As the population peaks and migration to the cities slows, the property industry needs to shrink. Attention should turn to getting the most out of China's existing housing stock.

In the short run, however, officials have little choice but to undertake a

bigger bail-out. The government wants state-directed lenders like China Development Bank to lend to local-government entities, which can in turn help developers that post collateral. The three red lines may be smudged, if not erased. Ambitious restructuring will be put off. The property crisis is a calamity in its own right. It is also another example, along with zero covid and a purge of tech firms, of Mr Xi botching the big calls over the world's second-largest economy. ■



【首文】房子着火了

中国的房地产危机并没有过去，事态每况愈下

官员们可能别无选择，只能救市

中国共产党第二十次全国代表大会再过几周就要召开，预计国家主席习近平在这次会议上将连续第三次当选中共中央总书记，此时一个本已严重的问题正变得越发令人忧惧。超过三分之二的城市家庭财富与房地产紧密相连，该产业支撑着五分之一的GDP。房地产市场正日益陷落，拖累了经济，甚至引发了小规模的社会动荡。

疯狂建造高楼大厦曾是中国崛起的象征。现在，人们对这一模式的信心已经崩溃。买家纷纷退出，借款人拒还房贷，开发商面对流动性紧缩。与去年同期相比，7月的新房销售额下降了29%。中国最大的开发商碧桂园发布了利润大幅下滑，并表示房地产市场“快速下行，行业进入寒冬”。

两年前，为了驯服房地产这头猛兽，政府对开发商贷款实施了限制，即“三道红线”。改革获习授权，他坚持认为“房子是用来住的，不是用来炒的”。最初的想法是更严厉的规定能让房地产公司更加克制，让炒房者打消念头，使房屋建设放缓到合理的速度。

去年地产巨头恒大违约，事情开始变得不妙。一年后，随着经济活动的衰退，战略已千疮百孔。这场危机现在是一个经济问题，也是一个政治问题。在中国一些地区，痛苦正在演变成反抗。贷款买房的业主们已经联合起来，要求逾期交付已久的房屋复工，否则将停止还贷。

问题的一方面是对新冠清零的执着。政府试图通过封锁来抑制疫情爆发，这重挫了信心——有2100万人口的成都是最近一个经受困境的特大城市。

另一方面，政府最初的计划没有解决增长与财务审慎之间的矛盾，也没有解决民众的需求与相互勾结的官员和开发商的动力之间的冲突。三道红线让房地产公司无法获得建完已预售楼盘所需的资金。已售楼盘迟迟不完工

令买家愤懑，又使得新楼盘更难卖出去。销售疲软加剧了现金短缺。而且因为缺乏清晰一致的破产程序，像恒大这样的公司的麻烦悬而未决。

中央政府一直在尝试迅速解决问题。它降低了利率，允许地方政府放松限购措施。它还鼓励地方政府帮助未完工的楼盘纾困。但地方政府缺乏缓解困境的资源，尤其是在房地产低迷影响了自身卖地收入的情况下。

中国的房地产市场需要重新设计。地方政府要有其他收入来源，以减少对卖地的依赖。未建成楼盘的预付款必须被更好地监管，防止欺诈和烂尾。随着人口达到峰值，向城市迁移的速度放缓，房地产行业需要收缩。关注点应转向最大限度地利用好中国现有的住房存量。

不过短期内官员们别无选择，只能展开更大规模的纾困。政府想让国家开发银行等由国家指导的银行向地方政府实体放贷，让这些实体可以去援助提供抵押品的开发商。三道红线即便不被擦掉，也可能被模糊化。雄心勃勃的结构性改革将会推迟。房地产危机本身是一个灾祸。它也是除清零政策和科技公司大清洗外，在世界第二大经济体的重大决策上搞砸的又一例证。 ■



Commodities

China's plunging energy imports confound expectations

A revival would cause problems—and not just for Europe

IN THE AFTERMATH of the global financial crisis in 2007-09, China's stimulus efforts, which pumped around 4trn yuan (\$575bn) into the economy, left observers gushing with praise. Robert Zoellick, then head of the World Bank, expressed his delight at the fiscal expansion. The IMF credited the world's second-largest economy with leading the global recovery.

This year, during a new period of economic turmoil, China is again helping to bring supply and demand back together—albeit in a very different way. With the price of fuels surging, the collapse in Chinese purchases of natural gas and other forms of energy has been an unexpected boon to countries around the world.

Arrivals of seaborne liquefied natural gas (LNG) have declined most markedly. China remains the largest LNG importer in the world but, between January and August, imports dropped by a fifth compared with the same period last year. That shortfall, at roughly 14bn cubic metres, is roughly equivalent to the entire annual LNG imports of Britain.

Industry experts had expected imports to grow throughout the year, if not as rapidly as they had in previous ones. But China's endless covid-19 lockdowns have caused a sharp drop in household spending and a meltdown in the residential property market has held back the construction industry. Meanwhile, volumes imported through the Power of Siberia pipeline, which pumps cheap Russian gas into China, have increased by an estimated 60% (this accounts for less than half the fall in seaborne imports).

It is not just imports of LNG—which is typically used for heating, industrial power and electricity generation—that have slumped. Lockdowns also mean considerably less travelling. Between January and July highway traffic fell by more than a third compared with the same period last year, reducing demand for petrol. Chinese crude-oil imports in August were 9% lower than last year, and the International Energy Agency, a think-tank, forecasts the first annual drop in oil demand since 1990. Coal imports were also down, by 15%.

What happens next is crucial. The behaviour of an importer as big as China moves prices, especially in a market under severe stress. An end to the country's "zero-covid" policies looks unlikely any time soon. But Chinese energy demand is muted even relative to last year when the approach was already in force, meaning demand may yet rise a little. The weather also makes a difference. If it is "exceptionally cold", China could return to the spot market, notes Laura Page of Kpler, a data firm, pulling much-needed LNG supplies away from Europe.

China's neighbours would also struggle in the face of a further squeeze. Price-sensitive buyers of LNG in developing economies in Asia are already being forced out of the market. According to the Institute for Energy Economics and Financial Analysis, a research firm, \$97bn-worth of infrastructure for LNG imports in Bangladesh, Pakistan, the Philippines and Vietnam risks being underused or mothballed if prices remain unaffordably high.

For good reason, the Chinese policies that have crushed energy imports this year will not gain the plaudits that the country's stimulus did during the global financial crisis. But European buyers of globally traded gas, already desperately scrambling for the imports needed to make it through the winter, will miss them if they go. ■



大宗商品

中国能源进口大降，出人预料

进口复苏会引发问题，不仅对欧洲而言

在2007年至2009年全球金融危机之后，中国政府推出刺激措施，向经济注入约四万亿元，令观察家们赞不绝口。时任世界银行行长罗伯特·佐利克（Robert Zoellick）对这番财政扩张表示欣喜。国际货币基金组织认为中国作为世界第二大经济体引领了全球经济复苏。

今年，在一个新的经济动荡期，中国正再次为平衡供给和需求做贡献，但方式与当年迥异。随着燃料价格飙升，中国对天然气及其他能源的购买量大减，对世界其他国家而言是个意料之外的福音。

通过海运进口的液化天然气（LNG）的下降最为明显。中国仍是全球最大的LNG进口国，但今年1月至8月期间的进口量比去年同期减少了五分之一，即约140亿立方米，大致相当于英国全年的LNG进口量。

行业专家曾预计中国的进口在今年全年都会保持增长态势，即便增速不如前几年迅猛。但是，中国无休止的疫情封控措施已导致家庭支出急剧下降，楼市崩溃也拖累了建筑业。同时，中国通过“西伯利亚力量”管道输入廉价的俄罗斯天然气，进口量估计增加了60%（相当于不到海运进口缩减量的一半）。

进口量大跌的不止LNG这一通常用于供暖、工业动力和发电的能源。疫情封控也意味着人们出行大大减少。与去年同期相比，1月至7月中国国内高速公路车流量下降超过三分之一，汽油需求也随之减少。中国8月的原油进口量比去年低9%，智库国际能源署（IEA）预测今年中国的年度石油需求会自1990年以来首次下跌。煤炭进口也下降了15%。

接下来会发生什么至关重要。像中国这样的进口大国，一举一动都会影响价格走势，尤其是在一个已经严重承压的市场。中国的“新冠清零”政策似

乎不太可能很快取消。但这一政策去年就已实施，而中国目前的能源需求甚至比那时还要低迷，这意味着需求可能仍有一点上升空间。天气也有大影响。数据公司Kpler的劳拉·佩奇（Laura Page）指出，如果天气“异常寒冷”，中国可能会重回现货市场，拿走欧洲急需的LNG供应。

进一步挤压也会让中国的邻国苦不堪言。在亚洲的发展中经济体中，对价格敏感的LNG买家已经在被迫退出市场。研究公司能源经济与金融分析研究所（Institute for Energy Economics and Financial Analysis）指出，假如价格继续保持在难以承受的高位，孟加拉国、巴基斯坦、菲律宾和越南总计970亿美元的LNG进口设施将有使用不足或停用的风险。

不消说，中国那些导致今年它能源进口大减的政策不会像它在金融危机时的刺激措施那样收获赞誉。但假如中国取消这些政策，已经拼命在全球天然气市场上争夺过冬所需的欧洲买家将会怀念不已。■



Bartleby

How to get things done—eventually

Dealing with your inner dawdler

“IF YOU WANT to change the world, start off by making your bed,” Admiral William McRaven told the graduating class of 2014 at the University of Texas, Austin. What the US Navy counts as “making your bed”—square corners, centred pillow, blanket neatly folded at the foot of the rack—is idiosyncratic. Yet the admiral’s broader point is universal: whether you are a sailor, a salesperson or a CEO, “if you make your bed every morning you will have accomplished the first task of the day.” His commencement speech went viral.

Everyone must battle the temptation to temporise every now and again; millions of beds go unmade each morning even on a looser definition than the navy’s. That is also true of people who, like your columnist, a guest Bartleby, more often suffer from the inverse affliction—having trouble putting things off even if they probably ought to be. Still, as someone with a perennial itch for completion, she has some tips for self-professed dawdlers who wish to make their lives more naval.

Start off by not calling yourself a procrastinator. Indeed, if you do, you are probably already the opposite. In “Out of Sheer Rage” (1998), Geoff Dyer elevates dilly-dallying to an art form. The book chronicles how the author was wasting his time instead of writing a study on D.H. Lawrence. “All over the world people are taking notes as a way of postponing, putting off and standing in for,” Mr Dyer writes, including supposedly about himself. If only he could make a start, he laments. Given that he managed not just to start but also complete, publish and market a brilliant book—even if the subject matter was less lofty than intended—the lamentations were in fact cogs of productivity.

The easiest way to get things finished is to get going in the first place. The reason busy people never stop moving is because their constant movement generates further momentum. This is, obviously, easier said than done—especially if you find a task unpleasant. The more objectionable something seems, the more time you spend thinking about just how awful it is. That in turn makes you even less likely to broach it—and so on. Being aware of this vicious circle does not guarantee you will break out of it. But it is, well, a start.

In practical terms, getting going can mean something as simple as opening an email. Two decades ago, in “Getting Things Done: The Art of Stress-Free Productivity”, an American time-management consultant, David Allen, warned readers that “the in-basket is a processing station, not a storage bin”. The email inbox, whose contents do not pile up on the desk, is even easier to confuse for a garbage can than a tabletop in-tray. Electronic correspondence is the starting point of most work projects, ever more so in the era of hybrid work. So just click it. And if you still find yourself avoiding things on your to-do list that make you anxious, involving others can help. Discussing tasks with colleagues can suppress the tendency to dodge the parts of your job you like the least.

Once you have got moving, consider your waypoints. That may mean breaking a job down into smaller, more readily achievable chunks. A seminal paper from 2005 by researchers at the Massachusetts Institute of Technology examined how conceptual knowledge is processed. The authors found that the brain prefers concrete and discrete tasks to broad and abstract ones. Set your sights on completing a document first, rather than starting out with the goal of crafting a complete strategy. Whatever you do, resist the urge of the overly concrete, like sharpening pencils.

Procrastination lies between logic and emotion, between ambition and achievement. Bridging that gap can be difficult, even when you know full-

well that if you do, the dreaded task will no longer lurk at the back of your mind like an unwanted squatter. Quick progress is difficult but rewarding, offering a high that is undiscoverable to those who leave things till the very end.

Putting something off doesn't make it go away. That trivial truth is worth repeating. Just ask the central bankers who kept delaying interest-rate rises even as economists warned of rising inflation. Now they must ratchet rates up further and faster, at the risk of provoking a recession. Most workplace decisions are not nearly as consequential but firms can still suffer material losses if employees put off tasks and decisions. So if that email arrives first thing in the morning, read it and reply—even if that means leaving your bed unmade. ■



巴托比

如何最终把事情做完

与你身体里的懒鬼交战

“如果你想改变世界，就从整理床铺开始。”威廉·麦克雷文（William McRaven）上将将对得克萨斯大学奥斯汀分校2014届毕业生说。美国海军“整理床铺”的标准别具一格——一切方方正正、枕头放在床头正中、毯子在床尾铺放整齐。但这位海军上将更宽泛的观点普遍适用：无论你是水手、销售人员还是首席执行官，“如果你每天早上都整理好床铺，你就已经完成了一天的第一项任务。”他的毕业演讲迅速火遍网络。

每个人时不时都得要抵抗一番拖沓的诱惑；即使把铺床的标准放得比海军更低，每天早上也会有无数张床乱糟糟地摊着。像笔者这样的人也不能幸免，尽管她更常遭受一种相反的痛苦——没办法把事情放一放再做，即使可能真的应该放一放。不过，作为一个总是不把事情做完就闹心的人，笔者有一些小妙招可以提供给那些自称懒鬼、希望自己的生活更向海军看齐的人。

首先，别管自己叫拖延症患者。事实上，如果你不这么叫，你很可能就已经不再是个拖延的人了。在1998年出版的《纯粹出于愤怒》（Out of Sheer Rage）中，杰夫·戴尔（Geoff Dyer）把磨蹭提升为一种艺术形式。这本书按时间顺序一五一十地记录下他如何各种荒废时间，而没有写出一部关于D.H.劳伦斯的研究。“世界各地的人都用记笔记来拖延、磨蹭和代替做正事。”戴尔写道，这当中据说也包括他自己。要是自己能起个头就好了，他哀叹道。考虑到他最后不仅起头写这本精彩的书（即使主题没有研究劳伦斯高级），而且还写完了，出版了并且做了营销，这些哀叹实际上成了生产力的齿轮。

要把事情做完，最简单的方法就是先行动起来。忙碌的人之所以忙个不停是因为他们的行动生成了更多劲头和活力。显然，这说起来容易做起来难——尤其是当某项任务令你不快的时候。某件事看起来越叫你反感，你就

越会花时间寻思它有多讨厌，这反过来又会让你更不愿意碰它——如此反复。意识到这个恶性循环并不能保证你会打破它，但这确实是个开始。

在实际操作中，行动起来可以是打开电子邮件这样简单的事情。二十年前，美国时间管理顾问戴维·艾伦（David Allen）在《搞定：无压工作的艺术》（Getting Things Done: The Art of Stress-Free Productivity）一书中警示读者，“收件篮是一个处理站，不是储藏箱”。电子邮件收件箱里面的东西不会在你书桌上堆起来，它甚至比桌子上的文件篮更容易被误认作垃圾桶。电子通信是大多数工作项目的起点，在混合工作的时代就更是如此了。因此，什么也别再说，点开它吧。如果你发现自己仍然在逃避待办清单上让你焦虑的事情，让别人参与进来会有所帮助。和同事讨论任务可以抑制你回避工作中最不喜欢的那部分的倾向。

一旦你开始行动，就可以考虑路径点了。这可能意味着将一项工作切分成更小、更容易完成的部分。麻省理工学院的研究人员在2005年发表了一篇开创性的论文，研究了人是如何处理概念性知识的。作者们发现，比起宽泛和抽象的任务，大脑更喜欢具体和离散的任务。先把你的目标放在完成一份文件上，而不是一开始就要制定出一个完整的战略。无论你做什么，忍住，不要去做太过具体的任务，比如削铅笔。

拖延横亘在逻辑和情感之间、雄心和成就之间。弥合这道沟壑可能很难，即使你完全明白如果你这样做了，可怕的任务将不再像一个撵也撵不走的讨厌鬼一样，潜伏在你的脑海深处。快速取得进展很难，却很值得，因为它能给人一种快感，那些把事情拖到最后一刻的人无从体会。

拖拉并不能让事情消失。这个微不足道的真理值得一提再提。不信问问各地的央行官员——经济学家警告通胀上升，他们却一直推迟加息。现在，他们必须冒着引发经济衰退的风险，更多更快地提高利率。工作场所中的大部分决策远没有这么事关重大，但是如果员工迟迟不能完成任务和做出决定，企业依然会遭受重大损失。所以，如果早上冒出来的第一件事就是收到了邮件，那就打开来看并回复吧——即使这意味你只能任由你的床铺凌乱着。■



Bartleby

Is there a point to exit interviews?

What to say when you are quitting your job

“DO YOU FEEL your job description has changed since you were hired?”

“What prompted you to start looking for another position?” Such questions are typical of the exit interview, to which an email from HR may invite you after you have handed in your notice. Do you accept? And if so, how honest should you be with your soon-to-be-ex-employer during the discussion?

Just like humans, corporate entities do not want to admit their faults. As such, many companies deal with resignations badly. Exit interviews may help them do better. More important, understanding why workers leave is critical if you want to stop more of them heading for the exit. Recruiting and training top talent is a big cost for firms, particularly those in the service sector, so anything that can be done to reduce staff turnover is valuable. Poaching is part of any competitive industry, so knowing what drew an employee to a different firm can be useful, too. Former employees who leave happy can in future fill a role as corporate ambassadors.

For firms the best exit interview is the one that doesn't happen. A study conducted by the Harvard Business Review concluded that they should be “the culmination of a series of regular retention conversations”. Such attempts will not work every time, or even often—staff churn is a fact of corporate life. For unsalvageable cases, some firms arrange a one-to-one conversation with the leaver's manager. Others offer an online form, which is less personal but provides the opportunity to collate feedback easily. Such exchanges are best scheduled after the initial rush of emotion has passed but before the employee has checked out mentally. The information gleaned can be revealing. In some firms, it travels all the way up to the board.

The incentives for a departing employee are less clear. (If you are pursuing legal action against your employer, your lawyer is likely to tell you to avoid the interview altogether.) It is tempting either to ignore everyone and just walk away or, conversely, to really let rip. “When one burns one’s bridges,” wrote Dylan Thomas, “what a very nice fire it makes.” But letting off steam by unburdening yourself of all the wrongs and little things that ever upset you is a shallow game.

The bottom line is, you never know. You can be denied a reference or unnecessarily complicate the paperwork related to your stock options and pension plan. Or you could miss a chance to turn a former employer into a client. Your columnist, a guest Bartleby, has no immediate plans to leave her current job. But if she ever did, and was asked to participate in an exit interview, she would agree to do so—and would advise you to do the same.

As in any break-up, the one with an employer involves dealing with elusive concepts such as decorum (“It’s not you, it’s me”) or closure (“Thank you for everything”). It is also transactional. As such, it pays not to be too candid. Whether the process happens over the phone, on Zoom, in person or in an online form, refrain from speaking your mind too freely. It is better to be excited about your new chapter than to unleash vitriol on colleagues who were unkind or censorious over the years.

Being too diplomatic is safer, unless it devolves into insincere platitudes. “This place is toxic” is bad; “the thing I admire about the leadership team is their long-term vision” may be worse. To strike the right balance it is useful to think of the exit interview as a performance appraisal in reverse. Outlining what you enjoyed most about the place (the pay, the camaraderie or the coffee) is a good place to start. Explaining what drew you to another employer can be particularly instructive. Gentle suggestions about what you would improve are fair game. Always remember that notes from the interview are official documentation that can be reviewed. Whatever you

do, do not post rude comments about your former employer on social media.

In his book “Liar’s Poker”, Michael Lewis tells the story of a senior trader quitting Salomon Brothers after being offered much more money by Goldman Sachs. His managers pleaded for him to stay, invoking loyalty to the firm; the trader retorted that if they wanted loyalty they should have hired a cocker spaniel. But a good exit interview should be about mutual graciousness when neither party has anything else to lose. For an employee to deny such a conference shows pettiness and resentment. For a company it is one last chance to leave a good impression. If you decide to part ways, why not do so on amicable terms? ■



巴托比

离职面谈有意义吗？

辞职时该说些什么

"你是否觉得自你受雇后你的职位描述发生了变化？" "是什么促使你开始寻找另一份工作？" 这都是离职面谈中的常见问题。在你递交辞呈后，人力资源部可能会发电子邮件邀请你做一次这样的面谈。你接受吗？如果接受，在讨论过程中，你又该对即将成为你前雇主的人诚实到什么程度？

跟人一样，企业实体也不愿承认自己有错。这就使得许多公司对辞职的处理都很糟糕。离职面谈可能会帮助它们改进。更重要的是，如果你想阻止更多人离开，了解员工决定走人的原因至关重要。招募和培训顶尖人才对企业来说是一笔巨大的成本，尤其是服务行业的公司，所以任何可以降低员工流动率的方法都很宝贵。任何竞争性行业中都少不了挖人，因此，了解是什么吸引了员工跳槽去别家也可能很有用。开开心心离职的前员工将来说不定可以充当旧东家的企业大使。

对企业来说，最好的离职面谈是根本就没举行的那种。《哈佛商业评论》的一项研究得出结论，离职面谈应该是“一系列常规挽留谈话的终点”。这样的尝试不会每次都奏效，甚至不会经常奏效——员工会流失是企业生活中一个铁打的事实。对于无法挽回的员工，一些公司会安排与离职者的主管进行一对一谈话。其他公司会提供在线表格，虽然没那么个人化，但提供了轻松整理反馈的机会。这种交流最好安排在最初的脑袋一热后冷静下来，但员工还没变得身在曹营心在汉的时候。收集到的信息可能具有启发性。在一些公司，这些信息会一直传达到董事会。

对离职员工的好处就没那么清楚了。（如果你正在对你的雇主采取法律行动，你的律师很可能会告诉你完全要避免面谈。）他们往往会很想谁也不搭理，拍拍屁股走人，或者相反地，扯破脸大闹一番。“当一个人烧掉退路时，”狄兰·托马斯（Dylan Thomas）写道，“那是多么美妙的火焰。”但是，将所有让你不愉快的冤屈和小事一吐为快以发泄情绪是个肤浅的游

戏。

最根本的问题是，世事难料。你可能拿不到推荐信，或者毫无必要地增加了与自己的股票期权和养老金计划相关的文书的复杂度。或者你可能会错失一个把前雇主变成客户的机会。笔者眼下没有离开目前这份工作的计划，但如果有，并被要求参加离职面谈，那还是会同意的——而且会建议你这样做。

正如任何分手情形一样，与雇主分手也要应对一些难以捉摸的概念，比如修养（“不是你的问题，是我的问题”），或者结束和释怀（“谢谢你所做的一切”）。同时它也是事务性的。因此，还是不要过于坦率比较划得来。无论这个过程是以电话、Zoom、面对面，还是某种在线形式进行的，都不要太过想说什么就说什么。对自己开启新篇章感到兴奋要好过以毒舌回击多年来不友善或吹毛求疵的同事。

宁可圆滑些会更安全，但不要沦为虚情假意的陈词滥调。说“这地方就是个火坑”不好，说“领导团队令我钦佩的一点就是他们眼光长远”可能更糟。要想把握好这中间的度，把离职面谈想成一场反向的绩效评估会有帮助。列出你最喜欢这个地方的什么（薪水、同事情谊或咖啡）是个不错的开头。解释另一家雇主哪些方面吸引了你可能会特别予人启发。温和地建议公司做些什么改进也无伤大雅。永远记住，面谈的笔记是官方文件，可能会有人审查。不管你做什么，千万不要在社交媒体上发布对前雇主的粗鲁评论。

在《说谎者的扑克牌》（Liar's Poker）一书中，迈克尔·刘易斯（Michael Lewis）讲述了一名高级交易员的故事。高盛给他开出丰厚得多的薪水后，他离开了所罗门兄弟（Salomon Brothers）。他的经理恳求他留下，拿对公司忠诚来说事；这名交易员反驳说，如果他们想要忠诚，应该雇一只可卡犬才对。但是，在双方都已经不会有什么别的损失之时，一次好的离职面谈应该互相展现宽和大度。对于一个员工来说，拒绝参加这样的会议显得小气和记仇。而对于公司来说，离职面谈是给人留个好印象的最后机会。如果你们决定分开，为什么不好聚好散呢？ ■



America Inc

Joe Biden's industrial policy is big, bold and fraught with difficulty

From semiconductors to electric vehicles, the American government is going into business

THE PRESIDENT had a skip in his step as he walked to the podium in Licking County, Ohio, on September 9th. It was a ground-breaking ceremony for a new Intel factory, a centrepiece in America's efforts to re-establish itself as a manufacturer of semiconductors. In fact work at the site had already begun, and a couple of yellow construction vehicles, undeterred by the occasion, continued rolling behind Joe Biden as he spoke. Wearing his trademark aviator sunglasses, he outlined the government's plans to invest in everything from quantum computing to biotechnology: "We're going to make sure we lead the world in industries of the future."

It is nothing new for a president to boast of America's clout in technology. It is more unusual to put a spotlight on the state rather than the private sector as the source of that clout. Industrial policy—an attempt by the government to cultivate strategically important sectors—has typically been seen as anathema by political and economic leaders in America in recent decades. With the notable exception of defence production, they have frowned on state involvement in business as counterproductive. The state's share of research and development funding has steadily shrunk (see chart).

But views have been evolving fast, partly as a response to China's economic model. Many in Washington now think that a more muscular industrial policy is essential to vouchsafing America's future vitality. And with the passage of a trifecta of ambitious laws under Mr Biden, the conversation is now turning towards questions about how exactly to implement it.

The sums involved are vast. An infrastructure law passed last November assigns more than \$20bn for new clean-energy technologies such as carbon capture and nearly \$8bn for electric-vehicle charging stations. A technology bill approved in July will put \$52bn into semiconductors while promising a further \$170bn to support research in other fields. An act passed in August allocates \$370bn to combat climate change, including investments in clean vehicles and renewable energy.

Together, all this may add up to nearly \$100bn of annual spending on industrial policy over the next five years. That might seem small relative to total federal expenditure of almost \$6trn this year, more than half of which goes to social priorities such as pensions. But it would roughly double the spending that can be categorised as industrial policy, based on estimates by the Centre for Strategic & International Studies, a think-tank. This could grow to about 0.7% of America's GDP, catapulting it past France, Germany and Japan, keen practitioners of industrial policy.

America may yet end up falling short of that. Much of the funding for scientific research will need to be approved each year by Congress. Still, the shift is dramatic.

Until now, America's main industrial-policy programmes have been in the Department of Defence. There have been a few other initiatives. But nothing has been as successful as the defence industrial system, the fount of innovations that have spread to civilians, from nuclear power to the building blocks of the internet.

The legislation passed under Mr Biden draws on that experience. "This is an effort to take some of those defence approaches and move them into what has historically been the civilian side of government," says William Bonvillian of the Information Technology & Innovation Foundation, another think-tank. New institutions are being created: the Office of Clean

Energy Demonstrations under the Department of Energy and a technology directorate under the National Science Foundation (NSF). Tobin Smith, an expert on science policy, says it will take the NSF well beyond its customary focus on pure research. “They are looking to advance new ideas and push them out into the marketplace,” he says.

The government is also taking a more hands-on approach in supporting the production of goods. That is most obvious in semiconductors, with \$39bn set aside as subsidies for factories and equipment. Intel’s new plant in Ohio is one beneficiary. The climate law contains production subsidies, too, including up to \$20bn in loans for new electric-vehicle factories.

The state will also serve as a customer for some of the emerging industries. Operation Warp Speed, America’s fast-track programme for covid vaccines, underscored how helpful it is to have the state as a buyer for more experimental products. Similar logic applies to renewable energy. The Biden administration believes that the procurement power of government can generate demand for 100 gigawatts of domestically made solar-power systems over the next decade—nearly as much as America’s installed solar-power capacity today.

| *Relax, the government’s in charge*

Yet the mind boggles at the complexity of implementation. The three bills create separate initiatives and separate pots of money. “There really isn’t a federal infrastructure, outside of the Defence Department, to manage these programmes,” says Mr Bonvillian. It does not help that some of the money has more to do with pork-barrel politics than industrial need.

On September 2nd the White House appointed John Podesta, a former top climate adviser to Barack Obama, to oversee the investments of more than \$300bn that will flow into clean energy. Some people are reassured that an experienced operator will run the show. But history suggests bureaucracies

struggle to innovate efficiently.

On top of all that are the uncertainties in America's politics. Donald Trump, though fond of building things, has vowed to root out the "deep state" and his former staffers talk about firing as many as 50,000 federal employees if he returns to office after the election in 2024. The industrial-policy machinery crafted by the Biden administration might struggle to survive.

It is easy to find sceptics about the government's chances of getting it right. "I'm very concerned...I would say that they will not succeed," says Gary Hufbauer of the Peterson Institute for International Economics, also a think-tank. Others are more optimistic. "You need to have a much more active and intentional policy if you want to bring into being industries that don't exist," says Todd Tucker of the Roosevelt Institute. But the debate about whether America should have a more muscular industrial policy is over. Like it or not, it is flexing those muscles. ■



美国公司

拜登的产业政策庞大、大胆、困难重重

从半导体到电动汽车，美国政府正在插手商界

九月九日，在俄亥俄州的利金县（Licking County），美国总统拜登步履轻快地走向演讲台。那是英特尔新工厂的奠基仪式，这家工厂是美国争取重新成为半导体制造中心的一项核心工程。事实上，它此前已经动工了，拜登讲话时，几辆黄色施工车辆不以为意地继续在他身后来来往往。他戴着标志性的飞行员墨镜，简要介绍了政府从量子计算到生物科技等方方面面的投资计划。“我们要确保我们能引领全球的未来产业。”

美国总统吹嘘自家的科技影响力不是什么新鲜事。较不寻常的是强调这种影响力源自政府而非私营部门。近几十年来，产业政策（即政府试图培育具战略意义的行业）一直被美国政治和经济界领袖视作洪水猛兽。除了明显例外的军工产业，他们反对政府插手商界，认为这会产生反作用。政府资金在研发投入中所占的份额一直稳步缩减（见图表）。

但这些观点已经迅速转向，这在一定程度上是为了应对中国的经济模式。现在华盛顿有不少人认为，要保证美国未来的活力，更强有力的产业政策至关重要。在拜登的主导下，三部雄心勃勃的法案已获通过，现在讨论转向该如何具体实施它们。

其中涉及的金额相当庞大。去年11月通过的一项基础设施投资法案为碳捕获等清洁能源新技术拨款200多亿美元，为电动汽车充电站拨款近80亿美元。7月通过的一项技术法案将给半导体行业带来520亿美元的拨款，还承诺另外投入1700亿美元支持其他领域的研究。8月通过的一项法令将拨出3700亿美元用于应对气候变化，包括在清洁能源车辆和可再生能源方面的投资。

全部加起来，未来五年每年在产业政策上的支出可能达到近1000亿美元。相对于今年美国联邦政府近六万亿美元的总支出（其中一半以上用于养老

金等重要社会事务），这也许是个小数额。但据智库战略与国际研究中心（Centre for Strategic & International Studies）估计，这将使可归类为产业政策的政府支出大概翻一番。而且这部分支出可能增长至约占美国GDP的0.7%，超越法国、德国、日本这些产业政策的忠实践行者。

美国最终可能不会走到这样的程度。大部分科研拨款还是要每年经国会批准。尽管如此，转变依然巨大。

到目前为止，美国主要的产业政策项目都在国防部。虽然也有一些其他项目，但都不如军工产业体系成功。源自军工的创新已然扩展到了民用领域，从核电到互联网的基础模块等。

拜登政府已获通过的立法借鉴了这一经验。“这是把国防上的一些做法拿来，用到政府里传统上属于民用的那一侧。”另一智库信息技术与创新基金会（Information Technology & Innovation Foundation）的威廉·邦维利安（William Bonvillian）说。新的机构正在建立起来：隶属能源部的清洁能源示范办公室（Office of Clean Energy Demonstrations）和隶属国家科学基金会（NSF）的一个技术理事会。科学政策专家托宾·史密斯（Tobin Smith）认为，这将使国家科学基金会的工作重点从以往的纯科研大大扩展至其他方面。“他们在努力促进新想法，并把它们推向市场。”他说。

政府在支持商品生产方面也更亲力亲为。最明显的是半导体，政府留出了390亿美元补贴半导体工厂和设备。英特尔在俄亥俄州的新工厂就是受益者之一。已通过的气候立法也包含生产补贴，包括为新的电动汽车工厂提供高达200亿美元的贷款。

政府还将成为一些新兴产业的客户。美国为加快研发新冠疫苗采取的“曲速行动”（Operation Warp Speed）凸显了政府作为更多实验性产品的买家所起的积极作用。类似的逻辑也适用于可再生能源。拜登政府认为，未来十年，政府采购对美国国产太阳能系统的需求可达到100吉瓦，接近于美国现在的太阳能装机容量。

| 放心，政府来管

然而，这要实施起来却是千头万绪。上述三个法案各有各的措施和资金库。“在国防部之外，真没有哪个联邦机构来管理这些项目。”邦维利安说。而且有些拨款更多是为了政治分肥，而非出于产业需求，也是个问题。

9月2日，白宫任命奥巴马政府时期的高级气候顾问约翰·波德斯塔（John Podesta）负责管理政府对清洁能源领域超过3000亿美元的投资。有经验丰富的人出来管事，这让一些人感到放心了。但历史表明，官僚机构难以高效创新。

除此之外，还有美国政局变数的问题。特朗普虽然喜欢制造东西，但他曾誓言要把“深层政府”连根拔起，他之前的幕僚曾谈到，假如特朗普赢得2024年大选而重返白宫，将解雇多达五万名联邦雇员。拜登政府精心打造的产业政策机制也许难以存续。

对美国政府能否搞好产业政策存疑的人不在少数。“我很担心.....我觉得他们不会成功。”彼得森国际经济研究所（Peterson Institute for International Economics）的盖里·赫夫鲍尔（Gary Hufbauer）说。其他人更乐观些。“要催生出全新的产业，就必须有一套积极主动得多、导向性强得多的政策。”罗斯福研究所（Roosevelt Institute）的托德·塔克（Todd Tucker）指出。但是，关于美国是否应该拿出更强力的产业政策，争辩已经结束。不管你是支持还是怀疑，美国已经在展示这方面的力量了。■



Margin brawl

The cloud computing giants are vying to protect fat profits

Amazon, Google and Microsoft are offering higher-end, stickier services

WHEN CHIEF executives ring the closing bell at the Nasdaq stock exchange in New York, it is usually because their firm has just gone public. When Adam Selipsky did so on June 27th, he was celebrating a tie-up with the bourse. He is the boss of Amazon Web Services (AWS), the tech giant's cloud-computing arm, and the deal is part of the exchange's shift of its stockmarkets to AWS's cloud. Tailored features include data transfer with minimal delay, which should please high-frequency traders. Nasdaq's customers will be able to use AWS's advanced analytics tools, such as machine learning (ML), through the stock exchange's platform.

The deal, first announced last November, came weeks after Alphabet, Google's parent company, unveiled a similar tie-up between GCP, its cloud offering, and CME, one of the world's biggest derivatives exchanges. A day before that deal was struck Microsoft Azure announced the rollout of its financial-services cloud. Clients include Morgan Stanley and HSBC, two banks. Not-so-big tech is wading in, too: IBM and Oracle also offer financial clouds.

Competition in the cloud is billowing. Alphabet, Amazon and Microsoft have together invested almost \$120bn in the past 12 months, most of it in data centres and the servers that power them. Amazon and Microsoft have seen their capital expenditure as a share of revenue rise by almost five percentage points in the past five years to 13% (see chart 1). Customers, increasingly irked by sky-high bills, are opting for more than one cloud service for fear of lock-in. "It's not a winner-take-all market," says an executive at a big cloud provider. Tech giants are battling to gain the upper hand.

All this should be putting pressure on stratospheric profits. AWS accounts for three-quarters of Amazon's operating income. Before this year's tech-stock slump some analysts reckoned it could become a \$1trn firm if spun out. Microsoft's Azure is thought to be just as profitable. Google, by contrast, is taking a hit as it tries to gain market share. It racked up \$3.3bn in cloud-related operating losses over the past 12 months, around 1% of Alphabet's revenue.

For now there is little sign of a margin squeeze. On July 28th AWS reported an operating margin of 29%, four times that of Amazon's retail business. Azure's margins, which Microsoft does not reveal, are believed to be steady, too. Google's cloud segment cut its operating losses from 16% of revenue in the previous quarter to 14%.

A combination of a fast-growing industry, hardware improvements and barriers to switching providers explains why margins have been elevated. But some of these factors are transient. The cloud giants are therefore preparing for a squeeze by trying to sell higher-margin software and by making their services even stickier. The result could be a vast cloud market offering a range of new capabilities to customers.

Cloud computing, still in its early days, is growing rapidly. AWS created the industry in 2006 as a way to make money from its excess storage capacity by offering to host other companies' data. GCP joined the fray two years later, followed by Azure in 2010. Partly because it moved first, AWS has 34% of the cloud-infrastructure market, still the largest share (see chart 2), according to data from Synergy Research Group. But Azure and GCP have made gains.

This year global sales from the entire industry are forecast to surpass \$495bn, according to Gartner, a research firm. That includes an ecosystem of firms selling services on top of or related to the cloud, such as Okta, a

maker of authentication software, and MongoDB, a database firm. It could grow to more than \$1trn by 2030. Today only 30% of enterprise workloads—applications, software programs or work that would have been run on a local server—have been shifted to the cloud.

Revenues of the big three “hyperscalers” are still growing at a decent clip. Last quarter AWS’s sales grew by 33% compared with the same quarter a year ago. Azure and GCP managed 40% and 36% respectively. Amazon and Google both have a backlog of multi-year contracts that are yet to be reported as sales of \$100bn and \$50bn respectively. (Microsoft does not publish this number.) Such growth has meant less pressure on margins.

The firms have also managed to cut the costs of hardware by making better use of old machines. Servers need to be upgraded less frequently than first thought, making clouds cheaper to run. The three tech giants have announced extensions to their average server lifetime from three to four years. On July 28th Microsoft went one better and said that it was extending it to six years, saving the firm about \$4bn in 2023. AWS is still running some of the servers it bought in 2006.

Taking chip design in-house has cut the costs of hardware by winning back margin from chip suppliers. AWS’s Graviton chips, designed by a team it acquired in 2015, lead the market. Google offers Tensor Processing Units, designed to boost ML capabilities, among other silicon. Microsoft is said to be trying to develop custom chips, too. In January it poached one of Apple’s top chip designers. Even as costs have fallen, prices have not followed suit, keeping margins high.

Margins are also protected by the fact that few companies have moved workloads from cloud to cloud. David Linthicum of Deloitte, a consultancy, says firms like to have the ability to switch but have rarely done so. One reason is that the benefit may be small, while costs can be prohibitive.

Hyperscalers charge “egress” fees for moving data out of their cloud.

Another barrier to switching has been that cloud providers tend to cater to different markets. AWS started as a service for developers and many of its clients are tech startups. Microsoft, by contrast, is more focused on large organisations. It uses its long-established enterprise-software business to cross-sell Azure. Like AWS, GCP’s customers are more often tech startups, partly because of its reputation for use of advanced technologies, though it also bundles cloud services with its advertising and productivity offerings for big customers.

The worry now for cloud providers, however, is that the factors that supported margins are starting to give way. The hyperscalers are increasingly hunting on each others’ turf. AWS and GCP are hiring ever bigger sales teams to help target large businesses. Microsoft is trying to increase its appeal to techies. It offers free Azure services to startups, including some provided by Github, a system for tracking changes in software code, which Microsoft acquired in 2018.

Egress fees may be falling, too. AWS cut some in December. Big customers are said to be able to negotiate discounts, sometimes forcing the tech giants to waive them completely. Costs may start to climb as the limits on extending server life are reached. And, crucially, growth will slow as the industry matures. One executive says that he expects competition to push margins down in the medium term. He also thinks that there is room for more competitors further up the “tech stack”.

Faced with the prospect of dwindling margins, the hyperscalers are trying to move up the tech stack themselves. One promising area is building software that runs on top of their servers for specific industries. Selling software is more profitable than selling hardware, because costs are lower and scaling easier. And software can be stickier too: it is easier for a

hospital to change its data-storage providers than the providers of its health-records database. The trend is showing up in hiring, say executive recruiters. Amazon, Microsoft and Google have been busy hiring bosses from various industries with the aim of selling cloud services back to the sorts of business they came from.

The cloud providers offer software for a range of organisations, from gaming firms and government to finance, as the AWS-Nasdaq deal demonstrates. They are buying their way into a health-care cloud, too. In 2021 Microsoft announced the acquisition of Nuance, a health-care cloud provider, for \$20bn. In June AWS invested in Oben Health and PeerCapsule, two health startups. The same month Oracle closed a \$28bn deal to buy Cerner, which develops electronic health-record software.

Another draw is high-end analytics, using techniques such as artificial intelligence (AI) and ML. Microsoft offers 26 such services, Amazon 25 and Google 12. Customers can analyse video images, convert speech to text and receive recommendations for improving their code. Google and Microsoft have invested heavily in quantum computing. The idea is to sell something that is difficult to replace, making switching harder. “The AI and ML offerings are all unique. They are done in radically different ways,” notes Mark Moerdler of Bernstein, a broker.

The shift towards software may not necessarily prove a huge success for cloud providers. Regulators are unlikely to look kindly at big tech’s attempts to dominate cloud-based IT services. And plenty of firms, such as Databricks and Snowflake, already sell cloud-based software. Customers will probably balk at being locked into a tech giant’s software services, much as they do with storage services.

Even so, the push shows where the cloud industry could go. Firms first adopted cloud computing to gain flexibility and to cut spending on data

centres. Now advanced analytics that sit on top of the cloud could offer customers new capabilities. Grocery stores use AI and video cameras to know when to restock shelves; Cirque du Soleil uses similar technology to analyse the emotional reactions of its audience when performers undertake death-defying stunts. Such new ML capabilities, delivered by the cloud at lower prices and combined with more data, greatly expand the upper bound of the cloud-computing market, notes Keith Weiss of Morgan Stanley.

These are the types of things that Satya Nadella, the boss of Microsoft, is referring to when he says that IT's share of GDP could double in a decade. If true, then dominance of the cloud market is worth fighting for. And the war is only just getting started. ■



利润大战

云计算巨头为保住丰厚利润展开竞争

亚马逊、谷歌和微软正在提供更高端、更具粘性的服务【深度】

CEO们在纽约纳斯达克证券交易所敲响收盘钟通常是因为自己的公司刚刚上市。6月27日，亚当·塞利普斯基（Adam Selipsky）敲响了这只钟，却是为了庆祝与这家交易所的合作。他是科技巨头亚马逊的云计算部门AWS的老板，纳斯达克正在把自己的交易所迁移到AWS的云上，此次协议是其中一部分。AWS为纳斯达克定制的服务里包括延时极小的数据传输，应该能赢得高频交易员的欢心。纳斯达克的客户则能通过交易所平台使用AWS先进的分析工具，比如机器学习。

该协议最早于去年11月宣布。再往前几周，谷歌母公司Alphabet公布了自己的云服务谷歌云平台（GCP）与全球最大衍生品交易所之一的芝加哥商品交易所（CME）的一项类似的合作。而在这项协议达成的前一天，微软Azure宣布推出自己的金融服务云，摩根士丹利和汇丰这两家银行都是它的客户。一些规模没那么大的科技公司也参与进来：IBM和甲骨文也提供金融云服务。

云服务的竞争如火如荼。过去12个月，Alphabet、亚马逊和微软总计投资近1200亿美元，主要花在了数据中心和驱动它们的服务器上。亚马逊和微软的资本支出占收入的比重在过去五年里上升了近五个百分点，达到13%（见图表1）。客户们越来越对天价账单不满，因为担心被套牢，他们开始不只选择一家云服务商。“这不是一个赢家通吃的市场。”一家大型云服务供应商的高管说。科技巨头们正在激烈争夺上风。

这一切都应该会对天价利润构成压力。AWS占亚马逊营业收入的四分之三。在今年科技股暴跌之前，一些分析师认为，如果它剥离出去，可能成为一家价值一万亿美元的公司。微软Azure的盈利能力也被认为不输AWS。相比之下，谷歌在试图抢占市场份额的过程中受到了冲击。在过去的12个月里，谷歌云服务方面的营业损失累计达33亿美元，约占Alphabet

收入的1%。

就目前来看，还没有出现利润缩水的迹象。7月28日，AWS报告的营业利润率为29%，是亚马逊零售业务的四倍。微软虽没有透露Azure的利润率，但据信也很稳定。谷歌上个季度云业务的营业损失从占收入的16%缩减到14%。

利润率上涨得益于行业快速增长、硬件改进，以及难以轻易更换供应商等综合因素。但其中一些因素是暂时的。因此，云计算巨头们正在试图销售利润率更高的软件，并进一步增加自己服务的粘性，以应对利润承压。这可能会造就一个为客户提供一系列新功能的庞大云服务市场。

云计算虽然还处在初期阶段，但发展迅速。2006年，AWS开始为其他公司托管数据，利用自己多余的存储容量赚钱，由此开创了云计算行业。两年后，GCP加入竞争，Azure随后在2010年加入。Synergy Research Group的数据显示，AWS之所以仍然以34%的份额在云基础设施市场称霸（见图表2），捷足先登是原因之一。但Azure和GCP都扩大了自己的份额。

根据研究公司高德纳（Gartner）的数据，今年整个行业的全球销售额预计将超过4950亿美元。这其中包括一个由众多公司构成的生态系统，它们销售“云上”服务或云相关服务，比如身份认证软件制造商Okta和数据库公司MongoDB。到2030年，销售额可能会突破一万亿美元。如今，只有30%的企业工作负载迁移到了云端，包括原本会在本地服务器上运行的应用、软件程序和工作内容。

三家“超大规模业者”的收入仍然在以相当可观的速度增长。上个季度，AWS的销售额同比增长33%。Azure和GCP分别增长40%和36%。亚马逊和谷歌积压的多年期合同未公布的销售额分别为1000亿美元和500亿美元。（微软没有公布这部分数字。）这样的增速意味着利润受到的压力不高。

三家公司还更充分地利用老旧设备，设法降低了硬件成本。服务器需要升级的频率低于最初的设想，降低了云服务的运营成本。这三家科技巨头已经宣布将服务器的平均使用年限从三年延长至四年。7月28日，微软更是

表示将延长至六年，在2023年将为公司节省约40亿美元。AWS仍在运行2006年购置的一些服务器。

自行设计芯片让它们从芯片供应商那里夺回利润，也降低了硬件成本。AWS在2015年收购的一个团队设计出了Graviton芯片，在该市场处于领先地位。除了其他芯片，谷歌还研发了旨在增强机器学习能力的张量处理单元（Tensor Processing Unit）。据说微软也在尝试研发定制芯片。今年1月，它从苹果挖走了一位顶级芯片设计师。成本下降了，价格却没有随之下降，这样就保住了高利润。

利润能保住的另一个原因是确实少有公司曾把工作负载从一个云平台迁移到另一个。咨询公司德勤（Deloitte）的大卫·林西库姆（David Linthicum）表示，虽然公司喜欢想迁就迁，却很少真这样做。一个原因是迁移的好处可能不大，价格却可能高得令人却步。超大规模业者都对把数据迁移出自家云收取“迁出”费。

迁移的另一个障碍是不同的云服务供应商往往针对不同的市场需求。AWS最初的服务对象是开发者，它的许多客户都是科技创业公司。相比之下，微软更专注于大型机构。它利用自己经营多年的企业软件业务交叉销售Azure。与AWS一样，GCP的客户大多是科技创业公司，一定程度上是因为它以使用先进技术而闻名，尽管它也将云服务与面向大客户的广告业务和生产率解决方案产品捆绑在一起。

然而，云服务供应商现在担心的是那些支撑利润率的因素开始消退。超大规模业者越来越多地在对方的地盘上猎食。AWS和GCP的销售团队日益扩大，以帮助拿下大企业客户。微软正试图加大对技术人员的吸引力。它向创业公司提供免费的Azure服务，包括由Github提供的一些服务。Github是一个用于跟踪软件代码更改的系统，在2018年被微软收购。

迁出费可能也在下降。去年12月，AWS下调了一些迁出费。据说大客户现在能通过协商获得迁出折扣，有时还能迫使科技巨头们全部免除这笔费用。随着超期服役的服务器最终到期，成本可能会开始攀升。而且关键的

一点是，随着行业成熟，增长将放缓。一位高管表示，他预计在中期内竞争会压低利润率。他还认为，在更高层次的“技术栈”上，还有空间让更多竞争对手加入。

面对未来不断下降的利润率，超大规模业者自身正在努力向技术栈的更高层攀登。一个有前景的领域是专为某个行业构建软件，在它们的服务器上运行。销售软件比硬件更加有利可图，因为软件的成本更低，也更容易扩展。而且软件也更具粘性，比如对医院来说，更换数据存储供应商要比更换病历数据库供应商容易。招聘主管们说，这一趋势开始显现在招聘中。亚马逊、微软和谷歌一直忙于聘请不同行业的高管，以求把云服务卖给这些人之前所在的行业。

云服务供应商为各种机构提供软件，包括游戏公司、政府，以及金融机构——正如AWS与纳斯达克的合作协议所展示的那样。它们也在通过收购打造医疗健康云。去年，微软宣布以200亿美元收购医疗云服务供应商Nuance。今年6月，AWS投资了两家医疗创业公司Oben Health和PeerCapsule。同月，甲骨文以280亿美元收购了电子病历软件开发公司Cerner。

另一个有吸引力的领域是使用人工智能和机器学习等技术进行高端分析。微软提供26项此类服务，亚马逊和谷歌分别推出了25项和12项。客户可以分析视频图像，将语音转换为文本，还可获得改进代码的建议。谷歌和微软都已大举注资量子计算。这都是为了能销售难被替代的产品，让用户更难更换平台。“人工智能和机器学习类产品都是独一无二的。它们都是以截然不同的方式打造出来的。”经纪公司盛博的马克·莫尔德勒（Mark Moerdler）指出。

向软件转移未必就能给云服务供应商带来巨大成功。监管部门不大会乐意看着科技巨头试图主导基于云的IT服务。而Databricks和Snowflake等很多公司已经在销售基于云的软件。客户可能不愿意被套牢在某家科技巨头的软件服务上，就像他们不愿意被套牢在某个存储服务上一样。

即便如此，这一努力也显示了云服务行业未来可能的走向。企业最初采纳云计算是为了获得灵活性并削减数据中心的开支。现在，基于云服务的高级分析技术可以为客户提供新的功能。杂货店使用人工智能和摄像头来知晓何时该补货；太阳马戏团（Cirque du Soleil）使用类似的技术分析观众在观看玩命的马戏表演时的情绪反应。这种以较低价格从云端提供并结合了更多数据的新的机器学习功能极大地扩展了云计算市场的上限，摩根士丹利的基思·魏斯（Keith Weiss）指出。

按微软老板萨蒂亚·纳德拉（Satya Nadella）的说法，IT占GDP的份额将在十年内翻一番。他所指的便是上述那些技术和服务。如果真如纳德拉所言，那么就值得为争取在云市场中的主导地位而开战。而这场战争才刚刚拉开序幕。■



The Economist Film

How are offices changing? Part 1

Demand for flexible working has risen for employees of multinationals across the world. A study found that at least some remote working is wanted by 76 of workers in Europe, 86 in America and 78 in Asia.



经济学人视频

未来办公室什么样？（上）

全球跨国公司员工对灵活工作的需求不断上升。一项研究发现，76%的欧洲员工、86%的美国员工和78%的亚洲员工希望“至少部分”远程工作。



Progress and its discontents

Bradford DeLong reconsiders the 20th century's economic history

“Slouching Towards Utopia” is a tale of stunning material progress—and of its limits

Slouching Towards Utopia. By J. Bradford DeLong. Basic Books; 624 pages; \$35 and £30

BETWEEN THE hot war in Europe and a brewing cold one between America and China, today's world has a very 20th-century feel. Amid these echoes, historians and international-relations buffs have been reappraising the failure of liberal democracy to consolidate its victories over rival political systems. In his new book, Bradford DeLong of the University of California, Berkeley, places the successes and failures of the 20th century in their economic context. In doing so, he provides insights into how things have gone wrong in more recent years—and what must go right if catastrophe is to be avoided in the current century.

“Slouching Towards Utopia” is an impressive achievement, written with wit and style and a formidable command of detail. Ambitiously, Mr DeLong seeks to redraw the temporal map. Many historians—among them the late British scholar Eric Hobsbawm—have preferred to chop modern history into a long 19th century, stretching from the French revolution to the crisis of 1914, and a short 20th, ending with the fall of communism. Mr DeLong, by contrast, argues that the period from 1870 to 2010 is best seen as a coherent whole: the first era, he argues, in which historical developments were overwhelmingly driven by economic ones.

At its outset, despite the Industrial Revolution, even the most prosperous parts of Europe and North America still had one foot firmly planted in a Malthusian world—in which, for millennia, technological improvements never yielded enough new production to outrun population growth.

Incomes had stuck close to subsistence levels. Yet from around 1870, growth found a new gear, and incomes in leading economies rose to unprecedented levels, then kept climbing.

The step-change in growth stemmed from technological advances, specifically three meta-innovations that drove rapid and sustained progress: the modern corporation, the research laboratory and globalisation. Thanks to these, a widening part of humankind hurtled towards “economic El Dorado”, a land of plenty that prior generations could scarcely have imagined.

Mr DeLong—an economist after all—helpfully quantifies the dramatic change in economic fortunes. For roughly 10,000 years before 1500, humankind’s productive potential (meaning the stock of useful knowledge, roughly corresponding to real output) doubled about once every three millennia. Over the following 370 years, that productive power doubled again. Thereafter, it rose at a pace of just over 2% per year, which equates to a roughly 20-fold rise in productive power over 140 years. It was economic magic, which allowed living standards to rocket even as the global population swelled to 7bn.

Had the denizens of the 19th century known how fantastically wealthy their descendants would become, many would have supposed those heirs lived amid peace and contentment. Yet building harmonious societies out of material abundance has proved maddeningly difficult.

Mr DeLong frames this history as a duel between the insights of Friedrich von Hayek, an Austrian economist who extolled the power of the free market, and Karl Polanyi, a Hungarian thinker who warned that the market was there to serve man, not man the market. In the years before the first world war, markets generated rapid growth—but also soaring inequality and jarring disruption. People pushed back, demanding greater political

rights, which they used to pursue regulation of the economy and social insurance. After the war, both the Polanyian and Hayekian impulses contributed to disasters: in the totalitarian socialism of the Soviet Union on the one hand, and, on the other, in the Depression, which persisted and deepened until politicians eventually abandoned laissez-faire orthodoxy.

In the aftermath of the second world war, though, the mix of a market economy and a generous safety-net made for a happy marriage of Hayek and Polanyi—“blessed by Keynes” (as Mr DeLong puts it), who provided the insight that governments should act to prevent recessions. The union bore fruit, in the form of a three-decade post-war run of torrid growth never matched before or since. And yet the last third of Mr DeLong’s long 20th century was coloured by disappointments.

When growth sagged and inflation rose in the 1970s, voters supported politicians promising market-friendly, or “neoliberal”, reforms, such as lower taxes and reduced regulation. (During a stint in Bill Clinton’s Treasury department, Mr DeLong was himself a steward of such policies.) Those reforms failed to keep growth high and led to worse inequality—yet rich countries pressed on with them, the author writes, up to the global financial crisis and the end of the long 20th century.

| *The values gap*

Could things have gone better? In Mr DeLong’s version of history, key events are often the product of chance rather than structural forces. He reckons, for instance, that had victory in the Falklands war and the collapse of communism not seemed to validate the records of Margaret Thatcher and Ronald Reagan, voters might have been quicker to see the limitations of their economic outlook. But that analysis underestimates how deeply neoliberal ideas took root across both the left and the right, at least in the Anglosphere. Barack Obama was no Reagan nostalgist; his unwillingness to respond to the financial crisis in a more interventionist way seems to have

been grounded in a genuine belief that doing so would have made things worse.

Indeed, if this book has a weakness, it is its occasional reluctance to give credit to people's beliefs, rather than narrow economic concerns, as a driving force of history. Mr DeLong cites Max Weber's dictum that though "material interests may drive the trains down the tracks...ideas are the switchmen." The start of the 21st century suggests that faiths and myths and values are even more consequential than that.

"Slouching Towards Utopia" shows how economic growth can transform the world. It also demonstrates that material prosperity alone cannot transport people to the promised land. The future may well be shaped by fights about what can. ■



进步以及随之而来的不满

布拉德福德·德隆反思20世纪经济史

本书讲述了惊人的物质进步——以及它的局限【《无精打采地走向乌托邦》书评】

《无精打采地走向乌托邦》，布拉德福德·德隆著。Basic Books出版社，624页；35美元/30英镑。

欧洲正在打热战，中美之间正在酝酿一场冷战，今天的世界让人仿佛重新置身20世纪。在这些历史的回响中，历史学家和国际关系专家一直在反思，为什么自由民主制度在战胜了与之对立的政治制度后，却没能巩固胜利成果。加州大学伯克利分校的布拉德福德·德隆（Bradford DeLong）在他的新著中将20世纪的成与败放到它们所处的经济背景中。通过这样的视角，他为近些年为何会出现问题——以及如果要在本世纪避免灾难必须怎么做——提供了见解。

《无精打采地走向乌托邦》行文机智风趣、风格鲜明，对细节的精准把握令人惊叹。德隆力图重新绘制时间地图，可谓雄心勃勃。包括已故英国学者埃里克·霍布斯鲍姆（Eric Hobsbawm）在内的许多历史学家都倾向于把近代史划分为两部分：第一部分是漫长的19世纪，从法国大革命到1914年危机；第二部分是短暂的20世纪，以共产主义垮台而告终。德隆则认为，还是把1870年到2010年这段时期看作一个连贯的整体为好：他认为这是第一个历史进程主要由经济发展推动的时代。

尽管发生了工业革命，在这个时代开启之初，即使是欧洲和北美最繁荣的地区也仍有一只脚牢牢卡在马尔萨斯人口论中的世界——在这个世界里，数千年来，技术进步带来的产出增加从未跑赢过人口增长。人们的收入一直只能勉强维持温饱。然而，从1870年左右开始，经济增长获得了新引擎，领先的经济体的收入上升到了前所未有的水平，然后继续攀升。

经济的跨越式增长源于技术进步，特别是三种驱动了快速和持续进步的元创新：现代企业、科研实验室和全球化。得益于这三种创新，越来越多的

人飞奔向“经济的黄金国”，这是前人几乎无法想象的丰饶之地。

德隆毕竟是位经济学家，他对这种经济财富的巨大变化做了直观的量化。在1500年之前的大约一万年里，人类的生产潜力（指有用知识的储备，大致相当于实际产出）大约每3000年翻一番。而在1500年之后的370年里，这种生产能力又翻了一番。从1870年开始，它以每年略高于2%的速度增长，相当于在140年的时间里生产能力增长了近20倍。这是个经济奇迹——在全球人口暴增至70亿之时，人们的生活水平还在大幅提高。

假如19世纪的人知道自己的子孙后代会变得如此富有，他们中的许多人应该会以为这些后代生活在平静与满足中。然而事实证明，仅靠物质充裕来构建和谐社会的难度之大令人抓狂。

德隆将这段历史描述为奥地利经济学家弗里德里希·冯·哈耶克（Friedrich von Hayek）与匈牙利思想家卡尔·波兰尼（Karl Polanyi）之间的思想对决。哈耶克歌颂自由市场的力量，波兰尼则警告称市场应服务于人，而不是人为市场服务。在第一次世界大战之前的那些年里，市场带来了经济快速增长，但也带来了急剧扩大的不平等和令人不适的混乱。人们强烈反弹，要求获得更多政治权利，进而以此寻求经济监管和社会保障。一战之后，波兰尼和哈耶克的理念都促成了灾难：一边是苏联的极权社会主义，另一边是大萧条——大萧条持续并恶化，直到政客们最终放弃了自由放任的正统观念。

不过在二战之后，市场经济和慷慨的社会保障并举，让哈耶克和波兰尼的思想得以喜结良缘——用德隆的话来说就是“得到了凯恩斯的祝福”，因为凯恩斯指出政府应该采取行动防止经济衰退。这场联姻结出了硕果，那便是战后30年里一段空前绝后的经济高速增长期。然而，德隆“漫长的20世纪”的最后三分之一的的时间却被失望所笼罩。

上世纪70年代，随着经济增长放缓、通胀上升，选民们选择支持那些承诺实施市场友好型改革的政客。这种改革也称“新自由主义”，包括减税和减少监管等。（德隆自己在克林顿政府的财政部任职期间就负责实施这种政

策。) 这些改革未能让经济保持高增长，并导致了更严重的不平等——然而，德隆写道，富裕国家继续推行这些改革，直到全球金融危机爆发以及“漫长的20世纪”的终结。

| 价值鸿沟

事情是不是本可以不那么糟糕？在德隆对历史的诠释中，关键事件往往源自机缘巧合，而非结构性力量的结果。例如，他认为，如果没有马岛战争的胜利和共产主义的垮台看上去证明了撒切尔夫人和里根的政绩，那么选民可能会更早看到他们经济观的局限性。但是，这样的分析低估了新自由主义思想在（至少是英语国家）左右两翼中都扎根深固。奥巴马并不是推崇里根的怀旧者；他不愿用更加干预主义的方式应对金融危机似乎是基于一种真切的信念，认为这样做会让事情变得更糟。

由此看来，如果说这本书有什么不足，那就是它有时不愿看到人们的信仰——而不是狭隘的对经济的关切——是历史的推动力。德隆引用马克斯·韦伯的名言说道，尽管“物质利益可能驱动火车沿轨道前行……思想却是扳道工”。21世纪的开篇表明，信仰、迷思和价值观的作用甚至不止于此。

《无精打采地走向乌托邦》展示了经济增长如何可能改变世界。它也证明了仅靠物质繁荣不能把人们送到应许之地。那么靠什么能呢？围绕这个问题的争执很可能将塑造世界的未来。 ■



Blasted are the dealmakers

Firms' unwise addiction to mergers and acquisitions

A bumper year for dealmaking is likely to result in a painful hangover

THE DEATH KNELL for corporate America's greatest individual experiment in mergers and acquisitions sounded in November 2021 when General Electric announced its intention to split in three. A thousand deals were struck by Jack Welch, its notoriously gung-ho boss, who ran the American industrial and financial giant between 1981 and 2001. The pace did not slacken under his successor, Jeffrey Immelt. The result has been a monumental destruction of shareholder wealth. The firm's market value peaked at \$594bn in 2000. Today it is a relatively measly \$83bn.

This lesson notwithstanding, bosses just cannot shake the need to shake hands. In 2021 the urge reached fever-pitch: a record \$5.9trn-worth of deals were announced globally, \$3.8trn by operating companies and the balance by private-equity funds and special-purpose acquisition companies (see chart). Competition for assets was fierce and due diligence frenetic. The cost of capital was historically low and purchasers paid top-notch prices, at a record median valuation of 15.4-times earnings before interest, tax, depreciation and amortisation (EBITDA), according to Bain, a consultancy. The number of deals for highly-valued technology firms soared, accounting for a quarter of the total volume.

If history is any judge, many of these deals will destroy value. It is easy to identify disastrous deals: large goodwill write-downs or even bankruptcy are useful signposts. But measuring the performance of the average deal is tough; relative share price performance is a quick but noisy measure and asking a counterfactual "what if" question is crystal-ball stuff. A recent review of academic literature by Geoff and J. Gay Meeks at Cambridge University estimates that only a fifth of studies conclude that the average

deal produces higher combined profits or increases the wealth of the acquirer's shareholders. McKinsey, another consultancy, reckons that firms pursuing large deals between 2010 and 2019 had only a coin-flip chance of creating excess shareholder returns. Enough to put average Joes off dealmaking, but not budding Neutron Jacks.

Those chances of success are further reduced by the circumstances in which the latest crop of deals were struck. Times of frenzy, like last year, are particularly bad for matching suitable buyers and sellers. Dealmaking tends to snowball as chief executives, keen to expand their dominions (and compensation), watch others make their moves and are unable to stand idly by while competitors make hay. Unprecedented competition from private-equity funds only intensifies the urge to move fast. Compounding their zeal are the middlemen. Investment bankers, who get paid by the deal rather than by the hour, convince them anything is possible: flattery is hard currency in the market for advice.

There are few brakes on this train. Where activist investors might agitate on the sell-side of a transaction for a higher price (often successfully), this kind of scrutiny is less common on the buy-side. Strong shareholder dissent in reaction to Unilever's abortive \$66bn bid for GSK's consumer health-care division in December 2021 is an all-too-rare example of owners holding trigger-happy management to account. Today the division, called Haleon, is listed on the London Stock Exchange, valued at around half of Unilever's offer.

The result has been ambitious deals made at high prices. Lower asset values are already exposing the flawed logic of some struck at the top of the market. In August Just Eat Takeaway.com, a European food-delivery firm, announced a write-down of the value of Grubhub, its distracting American misadventure, by \$3.3bn, barely a year after completing the \$7.3bn deal.

As equity markets tumbled this year, the shotgun weddings announced in 2021 were being consummated. After the thrill of courtship begins the hard task of post-merger integration. This complex process is the domain of consultants, organisational charts and budgeting, rather than clandestine negotiations and punchy projections. It is being turned on its head by a mix of inflation and slowing growth. Bosses bet big that high prices would be justified by higher profits. They are now running new businesses in a new world.

Buyers tend to overestimate the operational benefits of lumping two firms together (“synergies” in corporate speak). Often promised but seldom fully delivered, these projections persuade bosses that the pin factory is better in their hands than those of private-equity’s financial wizards. Scale was the *idée fixe* of dealmaking during 2021. Such deals are usually predicated on heavy cost-cutting, which is far harder while inflation rages. Add current supply-chain chaos to yo-yoing input costs, and managers soon find their powers waning.

That difficulty is apparent at Warner Bros Discovery, an American media giant formed in April 2022 through the merger of Discovery and WarnerMedia. In an industry among the worst at realising such targets came a promise of \$3bn of annual savings. Rising costs and cyclical pressures on advertising revenue mean that integration will be more difficult than planned. Expectations for EBITDA in 2023 are now \$12bn, rather than \$14bn when the merger was announced. The response of David Zaslav, the firm’s boss, has been to tighten the screws even further.

Labour is often the first cost bosses turn to, even if lots of layoffs raise the chance of rifts between new bedfellows. Many of the most spectacular blow-ups have involved cultural transplant-rejection at the highest levels, though as in AOL and Time Warner’s ill-fated \$165bn tie-up in 2001 this is usually a symptom rather than cause of strategic mismatch. Yet the real

risks occur further down the food-chain, as labour markets continue to convulse. The ability to retain good workers (“talent” in the integration dictionary) is critical. It comes high on the list of reasons why deals succeed in a recent survey conducted by Bain.

The war for talent has quickly turned into a great hiring freeze in the technology sector, but elsewhere labour shortages are the norm. Significant challenges await the integration of Canadian Pacific Railway and Kansas City Southern, a \$31bn deal announced in September 2021 which is awaiting its final regulatory stamps. The merger in 1968 of Pennsylvania and New York Central Railroad provides a warning from history. Shortly before the new entity’s bankruptcy in 1970, an internal report laid bare the role of high staff turnover in its failed integration: 61% of train masters, 81% of transport superintendents and 44% of division superintendents had been in their job for less than a year.

The dealmakers of 2021 entered the present inflationary period with a high bar to clear in order to justify the top-of-market deals they struck. As of now the mega-disasters of this wave of mega-deals are matters of speculation, though no one doubts they will emerge. Even this will not be enough to convince bosses to kick their dealmaking habit, at least while corporate balance-sheets remain strong. Activity has been remarkably resilient in 2022. Until bosses can be persuaded of other uses for their profits, new challenges mean only new types of deals. At least this year there may be a few bargains to be had. ■



着了魔的并购人

公司对并购上瘾可不明智

并购丰年很可能导致痛苦的后续反应

去年11月，通用电气宣布打算一分为三，给美国商界的单个最大并购实验敲响了丧钟。1981年至2001年，以狂热激进闻名的杰克·韦尔奇（Jack Welch）执掌这家美国工业和金融巨头，期间达成了上千笔交易。在其继任者杰弗里·伊梅尔特（Jeffrey Immelt）的领导下，并购的脚步也并未放缓。结果股东财富损失惨重。通用电气的市值在2000年达到5940亿美元的最高峰，如今只剩区区830亿。

这样的教训摆在眼前，老板们还是觉得有必要到处握手成交。2021年，这种冲动达到了狂热的地步，全球共达成价值5.9万亿美元的并购交易，创下历史记录。其中3.8万亿美元由运营实际业务的公司达成，其余是私募股权基金和特殊目的收购公司（见图表）。对资产的竞争十分激烈，尽职调查热火朝天。咨询公司贝恩的数据显示，资本成本处于历史低位，买方支付了高位价格，估值中值是息税、折旧和摊销前利润（EBITDA）的15.4倍，创下历史新高。高估值科技公司的交易数量猛增，占总交易量的四分之一。

如果拿历史作参照，这些交易中有许多都将破坏价值。识别灾难性的交易很容易，大额商誉减记甚至破产都是有用的提示。但要衡量一般的交易表现如何却很困难：相对股价表现是一种快速但易受干扰的指标，问一个与事实不符的“如果.....会怎样”的问题跟用水晶球问卜没什么两样。剑桥大学的杰夫·米克斯（Geoff Meeks）和J·盖伊·米克斯（J. Gay Meeks）最近回顾学术文献发现，只有五分之一的研究得出结论，显示一般交易产生了更高的总利润或增加了买方的股东财富。另一家咨询公司麦肯锡认为，在2010年至2019年期间进行了大笔并购的公司只有五成机会能为股东创造超额回报。这足以让一般的老板放弃并购，却吓不退新一代的“中子弹杰克”。

最新一批交易达成时的环境进一步降低了它们获得成功的机会。像去年那样的疯狂时期尤其不利于匹配合适的买方和卖方。交易往往会产生滚雪球效应，因为渴望扩大自己领地（还有提高报酬）的高管无法按兵不动，坐视他人抓住时机达成交易。来自私募股权基金的空前竞争只会加剧快速行动的冲动。给这种狂热火上浇油的是中间商。按交易而不是按小时获取报酬的投行家会说服高管相信一切皆有可能。奉承在咨询市场上可是硬通货。

这列高速行驶的并购火车上基本没有刹车。维权投资者可能会在交易卖方那边鼓动提高价格（通常能达到目的），但这种监督在买方中并不常见。联合利华曾在2021年12月对葛兰素史克的消费者医疗业务发出660亿美元的收购要约，但遭股东强烈反对而未果，这是一个非常罕见的股东向草率行事的管理层问责的例子。如今，葛兰素史克这个名为Haleon的部门在伦敦证券交易所上市，市值仅为联合利华当初报价的一半左右。

结果是雄心勃勃的交易都是以高价达成的。资产价值缩水已经暴露出一些在市场高位时达成的交易存在逻辑缺陷。欧洲食品配送平台Just Eat Takeaway.com 8月宣布将它收购的美国公司Grubhub减计33亿美元，此时距离它花73亿美元完成这笔令自己左支右绌的糟糕交易才不过一年。

今年股市暴跌之际，2021年宣布的闪婚式并购计划逐渐完成。你依我依的甜蜜期过后，艰巨的并购后整合就开始了。这个复杂的过程需要的是咨询顾问、组织架构图和预算制定，而不是秘密谈判和有利的预测。眼下通货膨胀和增长放缓的双重作用使得这个过程的条件因素完全颠倒。老板们押下重注，希望并购后更高的利润将证明出高价是合理之举，而他们现在要在一个全新的环境中经营新的业务。

买方往往会高估将两家公司合二为一后的运营效益（用企业界的行话就是“协同效应”）。这类预测常常画下大饼，但很少能够完全兑现，它们让老板相信收购对象在他们手中会比在那些私募股权的金融奇才手中经营得更好。2021年的交易执着于追求规模效应。此类交易通常以大幅削减成本为前提，而这在通胀肆虐的情况下难度大增。投入成本不断波动又碰上当前

供应链混乱，管理者很快就发现自己能做的少之又少。

探索频道（Discovery）和华纳媒体（WarnerMedia）在今年4月合并而成的美国媒体巨头华纳兄弟探索（Warner Bros Discovery）显然就存在这种困难。媒体行业在实现此类目标时一向在表现最差之列，而此次合并承诺每年将节省30亿美元的成本。不断上升的成本和广告收入的周期性压力会让这项整合比计划中的更难推进。宣布合并时对2023年的EBITDA预期为140亿美元，现在已经下调至120亿美元。对此，公司老板大卫·扎斯拉夫（David Zaslav）的反应是加大力度削减成本。

老板们在削减成本时往往会先拿员工开刀，哪怕大量裁员会增加新同事之间滋生裂痕的机会。许多最引人注目的纷争都与公司最高层发生的文化“移植排斥”有关。不过正如2001年美国在线（AOL）和时代华纳（Time Warner）1650亿美元的合并败局那样，这通常是战略不匹配的症状，而非原因。然而，在劳动力市场持续动荡之时，真正的风险存在于食物链的下游。留住优秀员工（整合术语中管这叫“人才”）的能力至关重要。在贝恩最近关于并购交易成功原因的一项调查中，这项能力名列前茅。

在科技行业，人才争夺战迅速演变为大规模的招聘冻结，但在其他行业里劳动力短缺是常态。加拿大太平洋铁路（Canadian Pacific Railway）和堪萨斯城南铁路（Kansas City Southern）的合并就面临着重大挑战，这笔价值310亿美元的交易于2021年9月宣布，正在等待监管批准。1968年宾夕法尼亚铁路（Pennsylvania Railroad）和纽约中央铁路（New York Central Railroad）的合并提供了前车之鉴。在新公司于1970年破产前不久，一份内部报告揭示了高员工流失率对整合失败的影响：61%的列车长、81%的运输主管和44%的部门主管在上岗不到一年后就离职了。

在2021年达成并购交易的老板们现在走进了通胀期，得做出很好的成绩才能证明他们的高价交易是划算的。到目前为止，这波巨额交易是否会演变出巨大灾难都还只是猜测，不过没有人怀疑一定会有灾难发生。但即便如此也不足以说服老板们改掉他们喜欢做交易的习惯，至少在公司的资产负债表依然强劲的情况下会很难。2022年，并购行动依然非常活跃。在能说

服老板们将利润用作他途之前，新的挑战只能意味着将出现新型的交易。至少今年可能会有几笔便宜的买卖。 ■



Schumpeter

Is Nvidia underestimating the chip crunch?

If so, so what?

JENSEN HUANG is a man literally schooled in adversity. When the co-founder of Nvidia, America's most valuable semiconductor company, was first sent to boarding school in Kentucky, little did his Taiwanese relatives realise that it was a school for troubled youths. He shared a room with a knife-scarred boy fresh out of prison. On some days he would either be picked upon or forced to clean the toilets. Far from buckling under the strain, he has said he learned to tolerate discomfort. That is a useful skill in the highly cyclical world of silicon chips.

Once again, the industry is in meltdown. In the tail end of the covid-19 pandemic in late 2021, when almost no one—from car companies to cryptocurrency miners—could get their hands on chips, semiconductor manufacturers, or fabs, went on a spending spree. Capital spending soared by almost 75% in six months compared with pre-pandemic levels, says Malcolm Penn of Future Horizons, a forecaster. Because of long lead times, much of that new capacity is still under construction. Yet in the meantime inflation, economic slowdown, Chinese lockdowns and a cryptocurrency collapse have buffeted demand. The purchase of computers and smartphones has also slowed. The result is a chip glut as stark as shortages were a year ago, hitting many chipmakers' profits.

That even includes Nvidia, which has replaced Intel as the bluest chip of American chip companies. On August 24th it reported a staggering slide in second-quarter earnings, while slashing revenue forecasts for the third time since May. From a peak valuation of more than \$800bn in late 2021, it is now worth less than \$400bn. True to form, Mr Huang remained sanguine. By early next year, he said after the earnings release, he expects

exciting new chip architectures for data centres and gaming, Nvidia's two biggest businesses, to revive its fortunes. Yet as he looks through his spectacles at the dazzling new models that he thinks will change the face of artificial intelligence (AI), as well as more nebulous concepts like the metaverse, is there a danger that he is underestimating the brutality of the here and now?

For short-term investors, there obviously is. Things could get worse, especially in crypto. Nvidia has long been sniffy about the way cryptocurrency miners have bought up its graphics processing units (GPUs), chiefly designed for gaming, to mine Ethereum's ether, the second-largest cryptocurrency. The last time its revenues crumbled in late 2019, the main culprit was a collapse in the price of ether, which it had woefully underestimated as a risk. That crash was short-lived. By the time the pandemic hit a few months later, the craze for ether helped propel Nvidia's stratospheric stockmarket recovery. Matt Bryson of Wedbush Securities, a broker, says that at the peak sales of chips for crypto mining may have generated about 20-25% of its gaming revenues. However reluctant Nvidia was to associate with the cryptoverse, the serendipity played hugely in its favour.

No longer. This year the price of ether has tanked, and though Nvidia acknowledges the problem, it makes no attempt to quantify the impact. Moreover, Ethereum is thought to be on the verge of switching its blockchain technology used to validate transactions from "proof of work", which uses massive number-crunching powered by Nvidia's GPUs, to a less energy-intensive mechanism called "proof of stake", which will make GPUs redundant. Partly in anticipation of this, crypto miners have dumped their GPUs onto second-hand e-commerce sites like eBay, contributing to a sharp fall in prices. With revenues from Ethereum gone for good, the fear is that the crypto winter could turn into an ice age.

Another source of concern for investors stems from the use of GPUs in what Nvidia calls data centres and which includes cloud computing and the processing of AI. A negligible business six years ago now eclipses gaming, once Nvidia's main source of revenues. Supply-chain disruptions meant that data-centre growth fell short of the firm's expectations in the second quarter. Moreover, though GPU demand from America's cloud providers such as Amazon, Microsoft and Google increased from the first to the second quarter, this was more than offset by weak sales to their counterparts in China. On August 31st Nvidia conveyed more bad news when it warned it could suffer a \$400m sales hit from new rules by the American government requiring it to obtain a licence before shipping some of its most advanced AI chips to China. There are other worries, too. One of the biggest is that, as the drive to accelerate the speed of AI models gathers pace, America's cloud providers will rely on their own chips, rather than Nvidia's GPUs. Competition from smaller chip designers could also heat up.

| *To the metaverse and beyond*

And yet Mr Huang can probably afford to remain insouciant. That is because, however cyclical the industry, several factors are likely to strengthen Nvidia's leading position in GPUs over the longer term, expanding its "moat". First, it is still reaping the rewards of a decision to supply software, known as CUDA, as well as chips, so that programmers can fine-tune the latter to their own specifications. Even if the cloud providers make their own chips, the software makes it easier for their enterprise customers to stick with Nvidia's GPUs. Second, Nvidia is betting on a brand new data-centre chip cycle that could hugely increase AI-processing capacity in areas ranging from writing texts to understanding life sciences. These "foundation models" are surging. Third, it leads in supplying chips for autonomous vehicles that, after many false starts, Mr Huang says could be Nvidia's next billion-dollar business.

It may be common for tech bosses to shrug off short-term busts to keep the focus on long-term dreamscapes. But the good thing about chip busts is that however nasty and brutish they are, they can also be mercifully short. It's a fair bet that when this one turns, Nvidia will still be at the forefront of the industry—and that semiconductors will be more crucial than ever. ■



熊彼特

英伟达低估了芯片困局吗？

如果是，那又怎样？

黄仁勋是真正受过“逆境教育”的人。这位美国市值最高的半导体公司英伟达（Nvidia）的联合创始人幼时先被送去了肯塔基州的一间寄宿学校，他的台湾亲人们不知道那是一所专为问题青少年而设的学校。他和一个刚刚出狱的刀疤男孩同住一个房间。在有些日子里他不是被欺负，就是被强迫清扫厕所。但他没有被压垮，相反，他说过自己因此学会了忍受不适。在高度周期性的硅芯片行业里，这是一项有用的能力。

这个行业眼下又一次滑入衰退。在2021年末新冠疫情的尾声，当从车厂到加密货币矿工的各行各业都拿不到芯片时，半导体制造商也就是晶圆厂开始了一轮大举砸钱。预测机构未来视界（Future Horizons）的马尔科姆·佩恩（Malcolm Penn）说，资本支出在六个月内相比疫情前水平飙升了近75%。由于投产准备期长，大部分新产能目前仍在建设中。然而与此同时，通货膨胀、经济放缓、中国的疫情封控以及加密货币崩盘令需求重挫。电脑和智能手机的购置也已放缓。结果是芯片一下子又过剩了，和不过一年前的芯片荒一样严重，打击了许多芯片制造商的利润。

这甚至包括了英伟达，它已经取代英特尔成为美国最蓝筹的芯片公司。8月24日，英伟达报告第二季度收益下滑惊人，并自5月以来第三次下调收入预期。其市值已从2021年底超过8000亿美元的峰值跌至现在的不到4000亿美元。黄仁勋一如既往地乐观。他在财报发布后表示，预计到明年初，英伟达最大的两项业务——数据中心和游戏——将迎来激动人心的新芯片架构，重振公司命运。不过，当他透过他鼻梁上的眼镜片展望他认为将改变人工智能（AI）面貌的炫目新模型，以及像元宇宙这样更加朦胧不清的概念时，是否存在这样一种危险：他低估了此时此地的残酷现实？

对于短期投资者来说，显然是有的。事情可能会变得更糟，尤其是在加密领域。加密货币矿工过去大量购买英伟达主要为游戏设计的图形处理单元

(GPU) 用于开采第二大加密货币以太币，对此英伟达一直满不在乎。上一次公司营收大跌发生在2019年末，主要肇事者是以太币价格暴跌，这是它此前严重低估了的风险。那次崩盘很短暂。几个月后新冠疫情暴发时，以太币热又助力了英伟达股价惊人反弹。经纪商Wedbush Securities的马特·布赖森（Matt Bryson）表示，加密货币挖矿芯片销售在高峰期可能占到英伟达游戏收入的20%至25%左右。不管英伟达多么不想和加密世界搅在一起，这一机缘确实对它极为有利。

但好运不再。今年以太币的价格已经崩塌，而尽管英伟达承认了这个问题，也并没有试图量化这一影响。此外，以太坊刚刚变更了它用于验证交易的区块链技术，从“工作量证明”这一由英伟达的GPU驱动大量数字运算的机制，转变为名为“权益证明”的耗能更少的机制。这使得GPU变得冗余。一定程度上出于对这种变化的预期，加密矿工已将自己的GPU放到eBay等二手电子商务网站上出售，导致其价格暴跌。随着来自以太坊的收入一去不复返，人们担心这个加密寒冬可能会变成冰河期。

引发投资者关切的另一个问题是在英伟达所说的数据中心里使用GPU，这个部分包括云计算和AI处理。一个六年前还可忽略不计的业务现在已经超越了游戏业务，而游戏曾是英伟达的主要收入来源。供应链中断导致第二季度数据中心业务的增长低于公司预期。此外，尽管从第一季度到第二季度，来自亚马逊、微软和谷歌等美国云服务供应商的GPU需求增加了，但被对中国云服务供应商的销售下滑悉数抵消。8月31日，英伟达释出了更多坏消息，它警告说，美国政府的新规定要求它在向中国交付一些最先进的AI芯片前须获得许可，这可能会令它损失四亿美元销售额。还有其他担忧。最大担忧之一是，随着AI模型提速的步伐加快，美国的云供应商将开始依赖自己的芯片而不是英伟达的GPU。来自规模较小的芯片设计厂商的竞争也可能升温。

| 迈向元宇宙和更广阔天地

但黄仁勋或许有实力不以为意。这是因为，无论该行业怎样周期循环，从更长远看，有几个因素很可能巩固英伟达在GPU业务中的领先地位，扩大其“护城河”。首先，它仍然在收获自己的一项决策的回报：除了供应芯

片，它也供应名为CUDA的软件，让程序员可根据所需的规格微调芯片。即使云供应商自产芯片，这款软件也方便了它们的企业客户继续使用英伟达的GPU。其次，英伟达正在押注一个全新的数据中心芯片周期，它会极大地提高从撰写文本到理解生命科学等各种领域的AI处理能力。这类“地基模型”正在激增。第三，它在为自动驾驶汽车供应芯片中领跑。在经过了许多次失败的尝试之后，黄仁勋表示自动驾驶可能成为英伟达的下一个十亿美元业务。

不在意短期萧条而专注于长远筑梦在科技大佬中可能十分常见。但芯片衰退期有一点很不錯：无论多糟糕和残酷，它们却也可能很仁慈地为时并不长久。很可能发生的是，当眼下这个周期掉头时，英伟达仍将处于行业最前沿——而半导体将比以往任何时候都更不可或缺。■



The Economist explains

Will China's economy ever overtake America's?

Some economists think not

CHINA WAS once, centuries ago, the world's biggest economy. Many analysts expect it to regain that distinction in due course. But a host of difficulties besetting the Asian giant, some of which are self-inflicted, will delay the day it overtakes America to return to pole position. A growing number of economists now think that day may never arrive.

China's population is over four times bigger than America's. Its economy could therefore surpass America's in scale long before it matches it in sophistication. Its GDP per person needs to reach only a quarter of America's for its total GDP to become the biggest in the world. By one measure, China has already achieved that modest feat. Its GDP overtook America's in 2016 when translated into dollars at "purchasing-power parity", a method that tries to tally up the goods and services in each country using the same international prices.

But China's GDP still lags far behind America's when converted into dollars using the more familiar exchange rates that prevail in the currency markets. It reached \$17.7trn in 2021 compared with America's \$23trn. And China's growth has been hampered by its zero-covid policy (which responds to every outbreak of the virus with severe lockdowns) as well as a property slump, unreformed state-owned enterprises and a continuing tech war with America. The government's aggressive regulation of previously booming sectors, such as tech and education, has also depressed the mood. China's economy expanded by an impressive 8.1% in 2021, but it will be lucky to grow by even 3% this year.

In the longer term, China's ageing population will mean further difficulties.

The workforce could shrink by 15% over the next 15 years, according to some estimates. Capital Economics, a consultancy, thinks China's GDP might draw close to America's or even surpass it by the mid-2030s only to fall behind again as its demographic decline asserts itself.

One of the hardest and most neglected questions in this debate is what will happen to the exchange rate between the two countries and to prices within them. Goods and services in China are still substantially cheaper than in America on average. If China does continue to narrow the productivity gap with America, its prices should also converge, either through a stronger currency or faster inflation. These movements can make a big difference. Goldman Sachs, for example, predicts that China's GDP will exceed \$38trn in 2031, at the prices and exchange rates prevailing in that year. That would be more than double its present total and enough to make it the world's biggest economy. But not all of that elevation will come from economic growth. Much of it will also come from higher prices and currency appreciation. According to the forecast, China's GDP will be about 47% bigger in real terms in 2031 than it was ten years earlier (an average growth rate of less than 4% a year). Its prices will be roughly 30% higher, and its exchange rate will be almost 13% stronger. It is the combination of these three factors, rather than growth alone, that will determine whether China ever becomes the world's undisputed economic heavyweight champion. ■



学人解惑

中国经济会超越美国吗？

有些经济学家认为不会

几个世纪前，中国是世界上最大的经济体。许多分析人士预计它有一天会重拾这一殊荣。但是种种困难侵扰着这个亚洲巨人——有些是它自己造成的——将推迟它超越美国重回这一地位的时日。现在，越来越多的经济学家认为这一天可能永远不会到来。

中国的人口是美国的四倍多。因此，中国的经济在规模上超过美国可能要远早于它在成熟完善度上匹敌美国。中国的人均GDP只要达到美国的四分之一，其GDP总量就能成为世界第一。按一项标准衡量，中国已经达成了这个不算很大的壮举。如果按“购买力平价”（试图用相同的国际价格加总计算各国的商品和服务）换算成美元，那么在2016年中国的GDP就超过了美国。

但是，如果用我们更熟悉的货币市场汇率来换算成美元，那么中国的GDP仍然远远落后于美国。中国的GDP在2021年达到17.7万亿美元，而美国为23万亿美元。中国的经济增长受到了多方面阻碍，除了房地产低迷、国有企业缺乏改革、与美国持续的科技战，还有清零政策（每次疫情爆发时都采取严格的封锁措施）。政府对科技和教育等此前蓬勃发展的行业的激进监管也令情绪低迷。中国经济在2021年增长了8.1%，成绩骄人，但今年即便能增长3%已算幸运了。

从长远来看，中国的人口老龄化意味着困难会更多。一些估计显示，未来15年劳动力可能会减少15%。咨询公司凯投宏观（Capital Economics）认为，到本世纪30年代中期，中国的GDP可能会接近甚至超过美国，但随着人口衰退的影响显现又会再度落后。

在这场辩论中，最难回答也最被忽视的问题之一是两国之间的汇率以及两国内部的价格会有什么变化。平均来看，中国的商品和服务仍然比美国便

宜很多。如果中国继续缩小与美国的生产率差距，那么它的价格也应该会趋近美国，要么通过更强势的货币，要么通过更快的通胀。这些变化会产生很大的影响。例如，高盛预测，在2031年，按届时的价格和汇率计算，中国的GDP将超过38万亿美元。这将是中国目前GDP的两倍多，足以令它成为世界上最大的经济体。但这里的提升并非全都来自经济增长。其中很大一部分源自价格上涨和货币升值。按这一预测，2031年中国的实际GDP将比2021年增长47%（平均年增长率不到4%）。中国的价格将上涨约30%，汇率将上升近13%。这三大因素的综合作用——而不仅仅是经济增长——将决定中国某天能否成为无可争议的世界经济重量级冠军。 ■



Weather

Heatwaves and floods around the world may be a taste of years to come

La Niña and climate change combine to create a spate of extreme weather in 2022

THE RECENT floods in Pakistan have submerged a third of the country and left more than 1,100 people dead. Monsoon rains, the heaviest in a decade, caused flood surges of more than a metre in parts of the country. It is not the only part of the world to have endured extreme weather this year. Early on, Australia was hit with unprecedented rain and heat. In May record rainfall in Brazil led to mudslides and floods that killed over 100 people. By the summer, east Africa was suffering its fourth consecutive year of drought. Meanwhile, temperature records were broken in cities across Europe, and rivers there ran drier than at any point for 500 years. A 70-day heatwave across much of China saw temperatures regularly exceeding 40°C, with the country's two largest lakes dropping to their lowest recorded heights.

What explains the series of extreme events? Attributing any single weather event to climate change is a complicated business. Part of the difficulty reflects the intricate mechanisms of Earth's climate, where persistent warming is the ominous background hum against which numerous other patterns play out. "Every event is a combination of climate change and climate variability," says Caroline Wainwright, a climate scientist at Imperial College London.

| *Weather versus climate*

One of the most powerful sources of natural climate variability is the El Niño-Southern Oscillation (ENSO), a phenomenon in which the climate all around the tropics (and in some regions beyond) moves into one of two extreme states. It takes the first part of its name from conditions in the

Pacific Ocean. In a year without ENSO effects, the trade winds blowing east to west across the Pacific push near-surface warm water in the same direction. When the winds blow more weakly than usual, the warm water remains in the central and eastern Pacific, causing more rainfall in that part of the world, an event known as an El Niño.

When the winds blow particularly strongly, more warm water than usual accumulates in the western Pacific, causing more rainfall there, and more cold water comes up from the depths off the coast of South America. This is known as La Niña—a condition that the world has been in for almost all the past two years.

La Niñas bring with them certain statistically predictable effects, including droughts in Chile, the Middle East and the horn of Africa, and higher rates of rainfall in west Africa and South Asia (see chart). Though the interconnectedness of the global climate means that some effects will inevitably be felt farther afield, the strength of the causal chain fades with distance from the tropics. The fluctuations are big enough, though, to affect average global temperatures. Because they keep heat in the ocean from getting into the atmosphere, La Niñas tend to make the world cooler than it would otherwise be.

What is happening in Pakistan is likely to be a catastrophic concatenation of multiple factors. A hotter planet means there is more moisture in the air (an additional 7% for every extra degree Celsius), leading to more extreme rainfall and greater risks of flooding. This means La Niña-induced rainfall can be unusually deadly. Global warming also has an indirect effect, as high temperatures experienced in the Himalayas earlier this year accelerated the melting of glaciers and overloaded rivers. It is also possible that air pollution in the area, which complicates air-circulation patterns, may have a role to play as well. The World Weather Attribution Project, a global network of climate modellers, began work recently to disentangle the

various factors involved in Pakistan, with an assessment expected within the next few weeks.

La Niña itself may start to look different in a warming world, however. Though ENSO does not operate in isolation from climatic warming, the exact relationship between the two continues to perplex modellers. This year, for example, will be the third in a row with a La Niña, the first time this century such a “triple dip” has been recorded. Ordinarily, ENSO operates on a three- to seven-year cycle, with strong El Niños tending to be followed by a balancing La Niña. Not only is this year’s triple dip unexplained, says Mat Collins at the University of Exeter, it is not consistent with what climate models suggest will happen with climate change.

Climate models, however, are in greater agreement that the regions affected by La Niña will tend to expand over time. Angola, for example, which lies beyond the boundary of Africa’s traditional La Niña flooding zone, has this year experienced high rainfall during the La Niña season.

La Niña years are also getting warmer. This March, the authorities responsible for the Great Barrier Reef in Australia announced that the coral reef had experienced a mass bleaching event in which corals expel their symbiotic algae as a reaction to rising temperatures. Only the sixth such event of modern times, it was also the first to take place in a La Niña year.

This year’s La Niña may well be representative of those to come, with its higher temperatures, increased flooding and severe droughts. A pressing concern is the impact this will have on a world where resources are already sapped by a rapid succession of disasters. “We’re already not coping and it’s only getting worse,” says Maarten van Aalst, director of the climate centre for the International Red Cross and Red Crescent.

Equally fraught are questions of responsibility. Whether or not specific disasters were made more likely to occur by ENSO, climate change is doubtless playing a role in increasing their severity. This implicates richer countries most responsible for historic pollution, which have thus far largely been spared the worst consequences of their emissions.

This year's extreme-weather events, therefore, set a particularly dramatic backdrop for the upcoming COP27 meeting in Egypt, which will be held in November, with its long-awaited discussions on who bears the blame and, more important, who will foot the resulting bill. ■



天气

全球热浪和洪水可能是未来几年的缩影

拉尼娜现象和气候变化结合，在2022年造成一连串极端天气

巴基斯坦最近发生的洪水淹没了该国三分之一的土地，造成1100多人死亡。十年来最严重的季风降雨在该国部分地区造成高度超过一米的洪水。这不是今年世界上唯一遭受极端天气的地方。早些时候，澳大利亚遭受了前所未有的降雨和高温袭击。5月，巴西创纪录的降雨导致了泥石流和洪水，造成100多人死亡。到了夏天，东非连续第四年遭受干旱。与此同时，欧洲各城市的气温创下纪录，河流出现500年来未见的干涸。持续70天的热浪席卷中国大部分地区，气温常常超过40°C。中国最大的两个湖泊的水位降至有记录以来的最低。

这一系列极端事件如何解释呢？将任何单一的天气事件归因于气候变化是一项复杂的工作。这种困难部分反映了地球气候的复杂机制：持续变暖是不祥的背景，其上还有许多其他模式在发挥作用。“每一个事件都是气候变化和气候变率的结合。”伦敦帝国理工学院的气候科学家卡罗琳·温赖特（Caroline Wainwright）说。

| 天气vs气候

自然气候变率最强大的来源之一是厄尔尼诺-南方涛动（ENSO），这种现象指的是热带地区（以及其他一些地区）的气候进入两个极端状态之一。它的名字的第一部分来自太平洋上的状况。在没有ENSO效应的一年中，从东向西吹过太平洋的信风把接近海面的暖水推向同一方向。而当风比往常更弱时，温暖的海水会留在太平洋中部和东部，导致这部分地区出现更多降雨，这被称为厄尔尼诺现象。

当信风特别强时，西太平洋会积聚比平时更多的暖水，导致那里的降雨量增加，更多的冷水会从南美洲海岸附近的深处涌出。这被称为拉尼娜现象——过去两年世界几乎都处于这种状态中。

拉尼娜带来了某些在统计上可预测的影响，包括智利、中东和非洲之角的干旱，以及西非和南亚更高的降雨率（见图表）。尽管全球气候的相互联系意味着一些影响不可避免地在更远的地方感受到，但离热带地区越远，因果链的影响就越弱。不过，这种波动之大足以影响全球平均气温。因为它们阻止海洋中的热量进入大气，拉尼娜现象往往会使世界变得比原本更凉爽。

巴基斯坦正在发生的事情很可能是多种因素的灾难性叠加。地球更暖意味着空气中的水分更多（每升温一摄氏度就会增加7%），导致更多的极端降雨和更大的洪水风险。这意味着拉尼娜现象引起的降雨可能异常致命。全球变暖还有间接影响，因为今年早些时候喜马拉雅山的高温加速了冰川融化和河流泛滥。该地区的空气污染可能还使空气循环模式变得愈发复杂，这可能也有影响。全球气候建模员网络“世界天气归因项目”（World Weather Attribution Project）最近开始着手拆解巴基斯坦所涉及的各种因素，预计将在未来几周内做出评估。

然而，在一个变暖的世界里，拉尼娜现象本身可能会开始变得不同。尽管ENSO并非独立于气候变暖之外运作，但两者之间的确切关系仍然困扰着建模者。例如，今年将是连续第三年出现拉尼娜现象，这是本世纪第一次记录到这样的“三次探底”。通常，ENSO以三到七年的周期运行，强烈的厄尔尼诺现象往往会伴随着与之平衡的拉尼娜现象。埃克塞特大学的马特·柯林斯（Mat Collins）说，今年的“三次探底”不仅无法解释，而且与气候模型预测的气候变化不一致。

然而，气候模型更一致地认为，受拉尼娜影响的地区将随着时间的推移而扩大。例如，位于非洲传统的拉尼娜洪泛区边界之外的安哥拉，今年在拉尼娜季节经历了强降雨。

拉尼娜年也越来越暖和。今年3月，负责澳大利亚大堡礁的当局宣布，珊瑚礁经历了一场大规模的白化事件，珊瑚排出了与之共生的藻类以应对气温上升。这只是近代以来第六次这样的事件，也是第一次发生在拉尼娜年。

今年的拉尼娜很可能是未来拉尼娜的典型代表，会带来气温上升、更多洪水和严重干旱。一个紧迫的问题是，这将对一个资源已经被快速接连发生的灾难消耗殆尽的世界产生何种影响。“我们已经不堪应付，事情还在变得更糟。”国际红十字与红新月会气候中心主任马丁·范阿尔斯特（Maarten van Aalst）说。

同样叫人头痛的还有责任归属问题。无论ENSO是否提高了特定灾害发生的概率，气候变化无疑正在增加其严重程度方面发挥作用。这就指向了对历史污染负有最大责任的较富裕国家，迄今为止它们在很大程度上幸免于自身排放的最严重后果。

因此，今年的极端天气事件为即将于11月在埃及举行的COP27会议设置了一个特别触目惊心的背景，会上将发生人们期待已久的讨论：责任在谁？更重要的是，谁为后果买单？ ■



Thursday's children

The war has thrown Ukraine's surrogacy industry into crisis

But there are not many other places couples can go

WHEN MISSILES began falling on Ukraine in February one woman from the centre of the country faced an especially perilous evacuation. She was 30 weeks pregnant—with someone else's baby. The 31-year-old, who goes by the name Tamara for fear of abuse, was put on a bus to Poland by Delivering Dreams, the surrogacy agency she was working through. Her legs swelled up during the long journey. But Tamara made it to safety and in April gave birth to a healthy baby, who is now with its intended parents in America.

Before the war about 2,500 surrogate mothers gave birth in Ukraine every year, according to Sam Everingham, who runs Growing Families, a non-profit. The babies' intended parents are generally foreign couples, mostly from Europe and China. They appreciate Ukraine's clear laws about surrogacy, which ensure that they are recognised as their baby's legal parents from the moment of conception. They also like the cost. Mr Everingham reckons that having a baby by a Ukrainian surrogate costs between \$35,000 and \$55,000—about one-third of the price in America.

The Russian invasion, unsurprisingly, has thrown the industry into disarray. Surrogates have had to deliver in hospital basements. All pregnant women have had to put up with more limited health care, particularly in the east of the country where conflict is fiercest. Foreign parents, many of whom have been through lengthy fertility treatments and lost pregnancies before, fret from afar.

Ukraine's surrogacy agencies have responded to the catastrophe in very different ways. At the start of the war a handful of agencies initially stopped responding to emails and phone calls—leaving pregnant women with no

way of contacting the parents of the babies they are carrying. Online groups sprung up to connect parents and surrogates who have found themselves in this situation. Tamara used Facebook and her own detective skills to track down about 20 foreign couples on behalf of other surrogates.

But as the conflict continues agencies have found ways to keep delivering on their promises. Sensible Surrogacy, an agency with partners on the ground in Ukraine, paid to evacuate Ukrainian surrogates to Poland and the Czech Republic. There, the agency hired local staff to check in on the women and continue doing weekly blood tests for alcohol and other drugs. The catch is that surrogates have to return to Ukraine near their due date. If they give birth in Poland, where surrogacy is illegal, the intended parents do not automatically have any rights over the child.

For a while foreign couples who would normally have travelled to Ukraine for the births of their children had to pay local nannies to hand over newborns at border crossings. Britain began issuing visas to Ukrainian surrogates who were carrying babies for British couples. But now that fighting is predominantly in the south and east of the country, foreign couples are once again travelling to cities such as Kyiv and Lviv to collect their children.

Indeed, international surrogacy agencies say that interest in Ukrainian surrogacy crashed at the start of the war but is now rising once more. Global demand for surrogacy is increasing, in part because people are starting families later in life, which increases the risk that they will no longer be fertile. But in recent years Cambodia, India, Nepal and Thailand have banned surrogacy for non-residents for fear that women might be exploited. In Britain, only “altruistic surrogacy”, where the surrogate receives cash only to cover expenses, is allowed. That reduces the number of women willing to provide it.

Ukrainian women who have lost everything in the war could be exploited if dodgy types enter the industry. But Olha, a Ukrainian surrogate who is carrying her third baby for a foreign couple, says she doesn't regret her decision. She is being paid \$450 per month during her pregnancy. She will earn another \$18,000 when she gives birth. That is a life-changing sum in a country where GDP per person before the war was about \$4,800. "Surrogates are grown-ups," she says. "We know what we are doing." ■



星期四出生的孩子们

战火让乌克兰代孕业陷入危机

但求子的夫妇并无太多其他选择

今年2月导弹开始落入乌克兰境内时，该国中部的一名妇女踏上了一条尤其险恶的撤离之路。她已有30周的身孕——怀的是别人的孩子。这名31岁的女性因为担心遭到恶言恶语而化名塔玛拉（Tamara），她所在的代孕机构“交付梦想”（Delivering Dreams）将她送上了一辆开往波兰的大巴。长途旅行让她双腿肿胀。但塔玛拉最终安全抵达，并在4月诞下一个健康的婴儿，现在孩子已经送到了美国的委托父母身边。

非营利组织“成长家庭”（Growing Families）的负责人山姆·埃弗林厄姆（Sam Everingham）说，战前，乌克兰每年约有2500名代孕母亲分娩。这些婴儿的委托父母通常是外国夫妇，大多来自欧洲和中国。他们喜欢乌克兰关于代孕的法律清楚明确，确保从受孕的那一刻起就承认他们是孩子的合法父母。他们也满意这里的价格。埃弗林厄姆估计，在乌克兰通过代孕得到婴儿的费用为35,000到55,000美元——约为美国的三分之一。

毫不意外，俄罗斯的入侵使该行业陷入混乱。代孕母亲不得不在医院地下室分娩。所有孕妇都被迫忍受愈发有限的医疗服务，尤其是在冲突最激烈的东部。外国父母们（他们中许多都经历过漫长的生育治疗及流产）只能远远地担忧不已。

乌克兰的代孕机构对这场灾难的反应截然不同。战争爆发之初，一些机构一度中断了回复电邮和电话——导致孕妇无法联系到她们所怀孩子的父母。网络团体如雨后春笋般涌现，让陷入窘境的代孕者与委托夫妇取得联系。塔玛拉利用Facebook和自己的调查技能，帮助其他代孕者找到了大约20对外国夫妇。

但随着战事持续，各机构已经找到了继续履行承诺的办法。“明智代孕”（Sensible Surrogacy）是一家在乌克兰当地有合作伙伴的机构，它付

费将乌克兰代孕者疏散到波兰和捷克。在那里，该机构雇用当地员工照看这些妇女，并继续每周验血以检查酒精和其他药物。但还是有个问题：代孕者必须在预产期临近前返回乌克兰。代孕在波兰是非法的，如果她们在那里生下孩子，委托父母将不会自动拥有对孩子的任何权利。

外国夫妇通常会去乌克兰迎接孩子诞生，但有一段时间，他们不得不花钱请当地的保姆在边境口岸传递新生儿。英国开始给那些为英国夫妇代孕的乌克兰妇女发放签证。但现在战事主要集中在乌克兰南部和东部，外国夫妇又开始前往基辅和利沃夫等城市领回孩子。

事实上，跨国代孕机构称，在战争初期人们对乌克兰代孕服务的兴趣骤减，但现在重新升温。全球对代孕的需求正在增加，部分原因是人们推迟组建家庭，增加了不孕不育的风险。但近年来，柬埔寨、印度、尼泊尔和泰国担心女性可能遭受剥削，已经禁止为非本国居民代孕。英国只允许“无偿代孕”，代孕者收取的费用不能超过相关支出。这就减少了愿意提供代孕的女性数量。

如果不良分子进入这个行业，那些在战争中失去了一切的乌克兰妇女可能会受到剥削。但乌克兰代孕者奥尔哈（Olha）说，她不后悔自己的决定。奥尔哈正在为一对外国夫妇怀她的第三胎。她在怀孕期间每月可以收到450美元，生下孩子后，还能再得到1.8万美元。在一个战前人均GDP约为4800美元的国家，这笔钱足以改变人生。“代孕的都是成年人，”她说，“我们知道自己在干什么。”■



The mighty dollar

The dollar is as strong as ever. Isn't it?

Technology is undermining the clout of the global reserve currency

THE MOST important currency in the world is on a roll. The dollar has climbed by around 20% over the past year against a basket of global currencies, and is at its highest level in 20 years. One euro is worth less than a dollar, and other pretenders to the dollar's throne as the world's reserve currency, such as the yen, yuan or even crypto, have slumped. Even as America has used its financial clout to squeeze Russia, others have rushed to the dollar-based financial system as a safe haven. This cyclical strength of the dollar dominates the global financial landscape. But look closer and technological shifts that could eventually challenge it are gathering momentum.

The dollar's run reflects several forces. Even as Europe and China face a downturn, America's economy is proving remarkably resilient, with job growth and profits still strong. Inflation is high and the Federal Reserve is raising rates faster and higher than other big central banks. Energy crises are terms-of-trade shocks that favour energy exporters and punish the currencies of importers. Thanks to the shale revolution America became a net energy exporter in 2019 for the first time since 1952. None of these dynamics looks likely to abate soon.

For America a strong dollar has some advantages. It will help bring down inflation, even if it might pose some longer-term competitiveness problems. For much of the world, though, it is bad news. The greenback remains pre-eminent in trade invoicing and cross-border debt. As a result, as the Fed raises rates and capital shifts to America, the finances of emerging markets get squeezed. So far big economies such as India have held up well, but smaller places with heavy debts, such as Sri Lanka and

Pakistan, are in big trouble.

The endurance of this global dollar-based system, in spite of the resentments it arouses, is testament to America's staying power. It has been through difficult times in the past 15 years, with a financial crisis, a badly handled pandemic, a widening fiscal deficit and a constitutional crisis in 2021. Nonetheless, even as the greenback soars, two technological developments bear close attention.

First, new state-run digital currency and payments systems are, at last, gaining traction. China's e-yuan now has 260m users and the technology involved might eventually allow China to run its own global payments network while maintaining capital controls, which it regards as necessary to maintain stability. That could make it all but immune to American sanctions. Elsewhere, state payments systems are exhibiting powerful network effects. India's UPI system is vast and Brazil's payments system, Pix, has been used by 126m people. Today these payments networks are domestic; tomorrow they could facilitate cross-border transactions as alternatives to the dollar-based system.

Second, if you look beyond the scams and bubbles in cryptocurrencies, decentralised finance technologies continue to improve. Developers are pushing through an upgrade to the Ethereum blockchain, on which most DeFi applications are based. On September 15th it switched to a new mechanism for making collective decisions known as proof-of-stake that is far less energy intensive: the drop in power consumption will be equivalent to Chile being switched off. It could pave the way for Ethereum to become more efficient at handling high transaction volumes—and a more credible global rival to traditional finance.

In the 20th century the dollar eclipsed sterling as the world's reserve currency, to become widely used as a unit of account, store of value and

means of payment. The next change in currency regimes may not be so clear-cut, as new technologies make it possible to separate out some reserve-currency functions—allowing countries to establish autonomy in payments, for example—without contesting the dollar’s role in other areas. The dollar’s reserve-currency status is not changing yet. But technology will change what it means to be a reserve currency. ■



【首文】强大的美元

美元坚挺一如既往。不是吗？

科技正在削弱这一全球储备货币的影响力

世界上最重要的货币一路上涨。过去一年，美元兑一篮子全球货币上涨了约20%，目前处于20年来的最高水平。一欧元兑换不到一美元，而觊觎美元世界储备货币王位的日元、人民币、甚至加密货币等已经大跌。在美国利用其金融影响力挤压俄罗斯的同时，其他国家纷纷涌向以美元为基础的金融体系，把它当做避风港。美元的这种周期性强势主导着全球金融格局。但仔细观察，最终可能挑战美元地位的技术转变正在积聚动力。

美元的走势是多股力量共同作用的结果。欧洲和中国经济低迷，而美国经济表现出明显的韧性，就业增长和利润表现仍然强劲。在通胀高企的情况下，美联储正在以比其他主要央行更快的速度和更大的幅度加息。能源危机这种贸易条件冲击有利于能源出口国，却殃及进口国的货币。在页岩油革命的推动下，2019年，美国自1952年以来首次成为能源净出口国。这些力量似乎都不会很快减弱。

对美国来说，美元走强有一些优势。它将有助于降低通胀，即使可能会带来一些长期竞争力的问题。不过，对于世界大部分地区来说，这可不是好事。美元在贸易结算和跨境债务方面仍然占据主导地位。因此，随着美联储加息和资本向美国转移，新兴市场的财政状况捉襟见肘。迄今为止，印度等大型经济体表现尚好，斯里兰卡和巴基斯坦等负债累累的较小经济体麻烦就大了。

这种以美元为基础的全球体系尽管引起了诸多不满，却一直屹立不倒，证明了美国的持久实力。在过去15年里，这一体系挺过了金融危机、新冠疫情防控不力、财政赤字扩大和2021年宪法危机等重重困难。尽管如此，在美元飙升的同时，仍要密切关注两项技术进展。

一是新的国家数字货币和支付系统终于开始小有成果。中国的数字人民币

现在拥有2.6亿用户，所用的技术最终可能让中国在运行自己的全球支付网络的同时继续维持资本管制——中国认为这种管制对于维持稳定不可或缺。这可能会让它几乎不受美国制裁的影响。在其他地方，国家支付体系正在显现强大的网络效应。印度的UPI系统非常庞大，而巴西的支付系统Pix已有1.26亿人使用过。今天，这些都还是国家内部的支付网络。将来，除了以美元为基础的系统之外，或许也可以通过这些支付网络来完成跨境交易。

其次，在加密货币领域的骗局和泡沫之外，去中心化金融科技仍在持续改进。开发人员正在推动升级以太坊区块链这一大多数去中心化金融应用的基础。9月15日，它切换到了一种称为“权益证明”的新集体决策机制，其电力消耗要少得多，减少的部分将相当于智利全国的电耗。这可以为以太坊在处理大量交易时提高效率，并成为传统金融更有竞争力的全球对手铺平道路。

美元在20世纪超越英镑成为世界储备货币，被广泛用作记账单位、价值存储和支付手段。货币体制的下一次变化可能没那么界限分明，因为新技术可以让分离部分储备货币功能成为可能——例如可以让各国在支付方面实现自主——而不会挑战美元在其他方面的角色。美元的储备货币地位尚未改变，但技术发展将改变储备货币的内涵。 ■



Destruction, little creation

The missing pandemic innovation boom

Digitisation and new ways of working were meant to unleash productivity growth. What went wrong?

AMONG THE trials and tribulations of the plague years, there was a silver lining. In late 2020, with the approval of covid-19 vaccines, and into 2021, as the jabs worked their magic, techno-optimism began to spread. If people could develop life-saving inoculations in months, why couldn't the world move out of its low-growth, low-productivity slumber? Firms could embrace digitisation as never before; the shift to working from home could allow people, free of office gossip and draining commutes, to work more effectively; before long there would be vaccines for every disease imaginable. Governments promised to spend big on science; companies outlined juicy R&D plans.

It was quite a change of mood. In the years before the pandemic, the rich world's growth rate had drastically slowed. In the 2010s American labour productivity—output per hour of work—grew at half the pace of the decade before. Societies had become worse at finding new ideas, translating them into innovations and promulgating these innovations. Robert Gordon's "The Rise and Fall of American Growth", published in 2016, argued that there were fewer life-changing discoveries to be made. In early 2020 a paper in the American Economic Review, a leading journal, made the case that, even where there were ideas to be discovered, they were getting harder to find.

The possibility that the dynamic had shifted was intoxicating, and not just because it suggested that some good would come of the pandemic. Productivity growth is the main driver of higher real wages. As the supply side of the economy expanded, inflation would become less of a problem.

And innovations would improve people's lives in ways not captured in the economic data. But our analysis comes to a depressing conclusion. So far, there is little sign that the global economy is getting more productive.

Official statistics are unusually volatile because of lockdown disruptions (see chart 1). In the second quarter of 2022 American GDP appeared to fall by 0.1%, even as the number of Americans on payrolls rose by 1.3m. Britain's GDP fell by the same amount, while employment rose by 150,000. Both economies are thus producing less with more people working. As a new paper by Mr Gordon of Northwestern University and Hassan Sayed of Princeton notes, today's weak productivity growth is the flipside of strong growth in 2020. Back then American firms fired their weakest workers, boosting productivity. Now they are rehiring them, dragging it back down.

Data published at higher frequencies support the notion that productivity growth remains poor. A global purchasing-managers index (PMI) compiled by JPMorgan Chase, a bank, asks bosses about the state of the broader economy and their business. A proxy for productivity derived from PMIs, which we calculate by subtracting the employment component of the index from the output component, has in recent months actually fallen. We find similar results when applying the same methodology to a real-time indicator of economic activity published by Goldman Sachs, another bank (see chart 2).

Why has the productivity boom failed to materialise? Optimists point out that investment spending is indeed roaring, as predicted—but caution that the benefits will only be felt slowly. There is often a lag of three to five years between higher business investment and productivity growth. New research by Jason Draho of UBS, another bank, concludes that “starting in 2024, the rest of this decade could look more like the second half of the 1990s than the second half of the 1970s”. Yet there are three reasons to worry that the pandemic innovation boom might never arrive.

The first relates to investment. Firms are not necessarily spending on things that lift productivity. In recent months, with customers facing empty shelves, many have scrambled to expand and protect supply chains. This improves resilience, but by creating redundancy it also increases costs. Many firms are also building up inventories, or stocks of raw materials and finished goods. Such spending counts towards investment, as measured in the national accounts, but has zero impact on productivity. In Germany in late 2021 the build-up of inventories accounted for 9% of total investment, the most ever.

Short-term crisis management has thus taken precedence over long-term innovation. In America R&D spending remains high, but our back-of-the-envelope calculation for 31 countries suggests that overall rich-world spending on “intellectual-property products” is running at about \$3trn a year—below its pre-pandemic trend. There is not much evidence of a boom in new discoveries and use of frontier technology. In 2020 economists talked excitedly about the coming wave of automation, as companies invested in AI and machine learning. But American imports of robots, in real terms, are no higher than shortly before the pandemic.

The second factor relates to working from home. Almost overnight much of the rich world moved from the office to the kitchen table. Many have stayed there: a third of paid full days in America are now done from home. This is great for work-life balance. But predictions that it would also help people work more efficiently, which pre-pandemic studies had suggested, are as yet unfulfilled. A recent survey of economists in America and Europe found that they were “uncertain about the long-term impact on productivity”. At home people might be able to focus more on “deep work”; they are also able to spend more time walking the dog.

Indeed, in some instances the pandemic has introduced inefficiencies—the third factor. Companies are still spending on extra cleaning and other

measures to make people feel safer, which will do little to raise profitability. With wave after wave of covid, workers are taking more sick days. In early summer an astonishing 4m Americans said they were off work because they had the disease or were caring for somebody with it, according to an official survey. In Britain, as people moved back to the office last year, the share of working hours lost to sickness jumped.

Perhaps, at some point, the rich world will enjoy the long-awaited productivity boom. But, adjusting for the volatility of the pandemic economy, Messrs Gordon and Sayed find “no room for a pandemic-era revival in productivity growth as has been widely suggested”. A large body of peer-reviewed evidence before the pandemic established that innovation had drastically slowed—and explained the reasons why that was so. Wishful thinking is not enough to change that. ■



大破坏，少创新

缺失的疫情创新潮

数字化和新的工作方式本应释放生产率增长。什么地方出了错？

在大疫年的考验和磨难中，还是有一线希望。随着新冠疫苗在2020年底获批并在2021年开始发挥魔力，技术乐观主义开始蔓延。如果人们可以在几个月内开发出挽救生命的疫苗，为什么世界不能从低增长、低生产率的沉睡中醒来？公司可以前所未有地拥抱数字化；在家工作的转变可以让人们摆脱办公室八卦和耗神的通勤，更有效地工作；不久之后，每种可以想象得到的疾病都会有疫苗。政府承诺在科学上投入巨资；公司描绘了宏伟的研发计划。

这是一种相当大的情绪转变。在疫情之前的几年里，富裕世界的增长率急剧放缓。在2010年代，美国的劳动生产率（每小时工作产出）的增长速度是十年前的一半。社会在发现新想法、将其转化为创新并加以推广这方面变得更糟了。罗伯特·戈登（Robert Gordon）于2016年出版的《美国增长的起落》（The Rise and Fall of American Growth）一书认为，剩余的可改变生活的发现越来越少。2020年初，顶级期刊《美国经济评论》（American Economic Review）上的一篇文章指出，即使有创意有待发现，也越来越难以找到。

态势变化的可能性令人陶醉，这不仅仅是因为它表明疫情还能带来一些好处。生产率增长是实际工资上涨的主要驱动力。随着经济供给面的扩大，通货膨胀将更不成问题。创新将以经济数据未能体现的方式改善人们的生活。但我们的分析得出了一个令人沮丧的结论。到目前为止，几乎没有迹象表明全球经济的生产率正在提高。

由于疫情封锁对经济的干扰，官方统计数据出现异常大的波动性（见图1）。2022年第二季度，美国GDP似乎下降了0.1%，尽管美国就业人数增加了130万。英国的GDP下降了同样的比例，而就业人数增加了15万。这样看来，这两个经济体中工作的人更多了，产出却减少了。正如西北大学的

戈登和普林斯顿大学的哈桑·赛义德（Hassan Sayed）在一篇新论文中指出的那样，今天疲软的生产率增长是2020年强劲增长的反面。当时美国公司解雇了能力最差的工人，从而提高了生产率。现在公司正在重新雇用他们，将生产率下拉回原处。

以更高频率发布的数据支持了生产率增长仍然疲软的观点。由摩根大通银行编制的全球采购经理人指数（PMI）询问老板们对更广泛的经济状况及其业务的看法。我们用该指数的产出分量减去就业分量，推导出一个生产率指标，而该指标在最近几个月实际上已经下降。将相同的方法应用于另一家银行高盛发布的实时经济活动指标，我们得到了类似的结果（见图2）。

为什么生产率繁荣未能实现？乐观主义者指出投资支出确实如预测的那样正在飙升，但提醒说其好处只会慢慢地感受到。更高的商业投资和生产率增长之间通常存在三到五年的滞后。另一家银行瑞银（UBS）的杰森·德拉霍（Jason Draho）的最新研究得出结论称，“从2024年开始，这个十年剩下的时间可能看起来更像1990年代的后半段，而不是1970年代的后半段”。然而，有三个理由担心疫情创新潮可能永远不会到来。

第一个与投资有关。公司不一定会在提高生产率的事情上花钱。近几个月来，顾客常常要面对空空如也的货架，许多公司于是争先恐后地扩大和保护供应链。这提高了韧性，但创建冗余也增加了成本。许多公司也在增加库存，也就是原材料和制成品的存量。此类支出在国民账户中被计入投资，但对生产率的影响为零。在德国，2021年末扩大库存占到总投资的9%，为有史以来最高。

这导致短期危机管理优先于长期创新。在美国，研发支出仍然很高，但我们对31个国家的粗略计算表明，富裕国家在“知识产权产品”上的总体支出每年约为3万亿美元，低于疫情前趋势。没有太多证据表明新发现和前沿技术应用呈爆发增长。2020年，随着公司投资人工智能和机器学习，经济学家们兴奋地谈论着即将到来的自动化浪潮。但美国的机器人进口按实值计算并不比疫情发生前不久更高。

第二个因素与在家工作有关。几乎一夜之间，大部分富裕国家的人都从办公室搬到了餐桌旁。许多人都待在了那里：现在美国有三分之一的全薪工作日是在家度过的。这非常有助于达到工作与生活的平衡。但是，疫情前有研究提出的远程工作还可帮助提高工作效率的预测尚未实现。最近对美国 and 欧洲经济学家的一项调查发现，他们“不确定（它）对生产率的长期影响”。在家里，人们或许可以更专注于“深度工作”，但也能花更多时间遛狗了。

事实上，在某些情况下，疫情导致效率低下——这是第三个因素。公司仍在花钱做额外的清洁和其他措施以让人们感到更安全，而这对提高盈利能力几乎没有帮助。随着一波又一波的新冠疫情暴发，工人们请了更多病假。一项官方调查显示，在初夏，数目惊人的400万美国人表示，他们因为染疫或照顾染疫者而停止工作。在英国，随着人们去年搬回办公室，因生病而损失的工作时间比例猛增。

也许，在某个时候，富裕世界将迎来期待已久的生产力繁荣。但是，在针对疫情经济的波动性做出调整后，戈登和赛义德发现，“没有出现普遍认为的那种疫情时代生产率增长恢复”。疫情之前有大量经同行评审的证据表明创新已经大幅放缓——并解释了何以如此。一厢情愿的想法不足以改变这一点。■



The Economist Film

How are offices changing? - Trailer

The pandemic and hybrid working have changed the very idea of the office.



经济学人视频

办公室的未来（预告）

大流行病和混合工作的兴起改变了办公室的含义。



Big plans for the 'stans

Two new railway lines could transform Central Asia

China, not Russia, stands to benefit

CENTRAL ASIA'S first railway was a military venture. Russia began laying track in 1880, primarily to shuttle troops around the Karakum desert, the better to crush resistance to its rule in what is now Turkmenistan. Within eight years trains ran 1,400km from the Caspian Sea to Samarkand. George Curzon, who rode the railway in 1888 as a young British lawmaker (and future Viceroy of India), wrote that it helped Russia dominate local trade, and doubled its capacity to launch attacks on India. Britain's strategy, he warned, was not "suited to a position where the Cossacks are at your gates".

Railways have underpinned Russia's clout in the region ever since. But today the balance of power is shifting. America has withdrawn from Afghanistan, leaving a vacuum. Russia is preoccupied with Ukraine. China sees an opening to expand its influence and diversify trade routes to Europe. Central Asian nations seek new connectivity too, with each other and to China. Integral to those efforts are two new railways that will be discussed at a summit of the Shanghai Co-operation Organisation, a group of regional powers including Russia and China, in Samarkand on September 15th-16th.

The first sign of progress came in May when Sadyr Japarov, Kyrgyzstan's president, announced that construction would start on a line connecting China, Kyrgyzstan and Uzbekistan (see map) in 2023. China's railways already connect to Central Asia's via Kazakhstan. The route from there through Russia to Europe has become a major conduit for trade in recent years. It carries the vast majority of China's railway trade with Europe, which grew from \$8bn of goods in 2016 to about \$75bn in 2021.

The new line would open a route from China to Europe through Turkmenistan, Iran and Turkey, shortening the journey by some 900km and eight days. More important, it would skirt Russia, which has become tricky to move goods across because of sanctions imposed as a result of Vladimir Putin's invasion of Ukraine. Yang Jie of the China Communications and Transportation Association says the war has caused "great uncertainty" for European customers. Some have switched to a slower, pricier rail-and-sea route, crossing the Caspian by ship to bypass Russia. The new line would provide an alternative, non-Russian, rail-only route between China and Europe.

Kyrgyzstan's transport minister, Erkinbek Osoyev, says the trans-Kyrgyz link will carry 7m-13m tonnes of cargo a year, mostly bound for other places. The jobs, taxes and transit fees generated would give Kyrgyzstan a hefty economic boost; the mountainous ex-Soviet state of 6.7m people depends heavily on remittances from Russia.

The concept is not new. Plans were drawn up first in 1997. Russia never liked the idea. China and Kyrgyzstan could not agree over the costs and the route, whether it would serve a wide swathe of Kyrgyz people or just cut straight through to Europe. There were differences over where to switch from the 1.435-metre gauge track used in China and Europe to the former Soviet Union's 1.520-metre standard. The plans were repeatedly shelved.

Mr Osoyev says China, Kyrgyzstan and Uzbekistan have finally agreed on a 280km route. It will cost \$4.1bn and be financed either through direct investment or public-private partnership. The route runs from the Torugart pass on China's border to Jalalabad in western Kyrgyzstan, which is already connected to Uzbekistan by a railway built by the Russians in 1916. The gauge would change at Makmal, site of a gold mine in which Chinese investors have an interest. Geological surveys are due to start soon and a feasibility study will be finished by March, Mr Osoyev says.

China's president, Xi Jinping, has endorsed the project. He is attending the Samarkand summit after a day in Kazakhstan, his first trip abroad since the pandemic began. Chinese experts arrived in Kyrgyzstan in August.

Uzbekistan's president, Shavkat Mirziyoyev, has given his blessing too, saying it will "link us to Asia-Pacific countries, paving the way for new economic opportunities". As for Russia, Mr Japarov says he has Mr Putin's personal approval. In July, the plan was backed by the Russia-endorsed Eurasian Economic Union.

Many foreign diplomats and experts are sceptical. They say there have been too many false starts and that Mr Putin's word is unreliable. They point out that Kyrgyzstan is politically unstable, laden with Chinese debt, and rife with anti-China sentiment. Detractors also note that many of China's foreign borrowers are struggling to repay loans, and that China is downsizing its belt-and-road infrastructure programme as a result. It will also need to extend its own railway by 160km.

Yet even the sceptics concede that there is momentum behind the latest railway plans. Central Asian governments are providing much of it. They want to improve connectivity with neighbours to hedge against future dominance by outsiders. Uzbekistan is the main cheerleader. Mr Mirziyoyev is in a strong position. He has earned respect from Western governments and international agencies since taking power in 2016 after the death of a Soviet-era despot. "Uzbekistan is the true driver in all of this, financially and logistically," says Niva Yau of the OSCE Academy, a research centre in Bishkek, Kyrgyzstan's capital.

Mr Mirziyoyev will also be championing another railway project at the Samarkand summit: a line connecting Uzbekistan to Pakistan via Afghanistan. A short one already runs from the Uzbek border to Mazar-i-Sharif in northern Afghanistan. The new one would stretch 573km, via Kabul, to Peshawar in Pakistan, thereby linking up with existing rail

infrastructure built by Britain during the late 1800s. Landlocked Uzbekistan and Afghanistan would get faster and cheaper access to the sea via Pakistan's ports. Backers estimate that it would cut the time it takes goods to travel from Uzbekistan to Pakistan from 35 days to around four. Pakistan and Afghanistan would earn transit fees. China's plans to turn Pakistan's Gwadar port into a shipping hub would get a boost. China would also gain an export route for a copper mine near Kabul in which it has an interest.

The idea of a trans-Afghan railway predates a trans-Kyrgyz one. Russia and Britain considered it in the early 20th century. So did Iran and the Soviets in the 1970s, as well as Western governments after the American-led invasion of Afghanistan in 2001. Familiar obstacles remain: treacherous terrain, security risks and dubious commercial viability. "Can you imagine building a railway through Afghanistan when you don't have total control over the political situation?" asks Temur Umarov of the Carnegie Endowment for International Peace, a think-tank. The World Bank warned against a similar route in 2012, citing the state of Pakistan's railways.

But the Taliban are now in power, and they back the railway. The new security worry is a local branch of Islamic State. Afghan and Uzbek authorities are working together to tackle that and create new economic opportunities. China has spent billions on infrastructure in Pakistan since 2012. Many projects have stalled but the railway could reinvigorate them, especially if other countries and multilateral lenders get involved. Uzbek, Afghan and Pakistani officials say they have asked the World Bank and other lenders for support.

The fate of both railways may depend on whether they can attract funding from sources besides China. Its belt-and-road problems have made it wary of financing infrastructure projects alone. The trans-Afghan railway thus looks shakier than the trans-Kyrgyz one, as America and its allies refuse to engage with the Taliban. There is a good chance that neither project

succeeds. But if either does, it will be a leap towards making the region better connected to the world, and less reliant on Russia. ■



“斯坦们”迎来大计划

两条新铁路线可能改变中亚

得益的将是中国，不是俄罗斯

中亚的第一条铁路是个军事项目。俄罗斯在1880年开始铺设铁路，主要是为了在卡拉库姆（Karakum）沙漠周边运送军队，以便更好地镇压当地（如今属于土库曼斯坦）对其统治的反抗。八年时间里，1400公里的铁路线从里海延伸到撒马尔罕（Samarkand）。1888年乘坐这趟铁路的年轻的英国议员乔治·柯松（George Curzon，后来成为印度总督）写道，它帮助俄罗斯掌控当地贸易，让俄罗斯进攻印度的能力翻了个倍。他警告说，英国的战略并不“适用于哥萨克人已经来到你家门口的情况”。

此后，铁路一直是俄罗斯在该地区影响力的支柱。但今天，力量的平衡正在转移。美国已从阿富汗撤军，留下了一个真空。俄罗斯忙于对乌克兰作战。中国看到了扩大自身影响力并实现中欧贸易路线多元化的机会。中亚各国也在寻求机会打造彼此之间以及与中国之间的新连接通道。其中的重要一环是9月15日至16日在撒马尔罕举行的上海合作组织（一个包括俄罗斯和中国在内的地区大国组织）的峰会上讨论的两个新铁路线项目。

取得进展的第一个信号是今年5月吉尔吉斯斯坦总统扎帕罗夫宣布将在2023年动工兴建一条铁路线，连接中国、吉尔吉斯斯坦和乌兹别克斯坦（见地图，以下简称中吉乌铁路）。中国的铁路之前就已通过哈萨克斯坦连接了中亚铁路网。近年来，从那里经俄罗斯到欧洲的铁路线已成为一大贸易走廊。它承载了中欧之间的绝大部分铁路贸易，货运量从2016年的价值80亿美元增长至2021年的约750亿美元。

中吉乌铁路将开辟一条从中国经土库曼斯坦、伊朗、土耳其到达欧洲的路线，整个行程缩短了约900公里，少花八天时间。更重要的是，它将绕过俄罗斯。普京派军入侵乌克兰令俄罗斯受到国际制裁，因此经俄罗斯运输货物已变得困难。中国交通运输协会的杨杰表示，这场战争给欧洲客户带来了“巨大的不确定性”。有人改用速度较慢、价格较高的铁路加海运路

线，穿越里海绕过俄罗斯。而这条新铁路将为中欧之间提供一条无须途经俄罗斯的全铁路直达路线。

吉尔吉斯斯坦的交通部长埃尔金贝克·奥索耶夫（Erkinbek Osoyev）表示，这条穿过吉尔吉斯的铁路的年货运量将达700万至1300万吨，大多是运往其他国家。随之而来的就业、税收和过境费将有力地推动吉尔吉斯斯坦经济。这个人口670万、境内多山的前苏联成员国目前严重依赖侨民从俄罗斯的汇款。

中吉乌铁路的概念并不是新提出来的。早在1997年就有了这样的计划。俄罗斯从来都不喜欢这个想法。当时中吉两国在成本和路线问题上（是服务广大地域内的吉尔吉斯人还是直线过境通往欧洲）无法达成共识。对于在哪个地点把路轨从中国和欧洲通用的1.435米轨距转换为1.520米的前苏联标准，双方也存在分歧。计划于是一再搁置。

奥索耶夫说，中国、吉尔吉斯斯坦和乌兹别克斯坦最终还是达成了协议，合力建造一条280公里长的铁路线。这将耗资41亿美元，资金来自直接投资或公私合营。中吉乌铁路从中吉边境的吐尔尕特山口（Torugart）西行至吉尔吉斯斯坦西部的贾拉拉巴德（Jalalabad），那里已有一条由俄国人在1916年修建的铁路连接乌兹别克斯坦。换轨操作将在马克马尔（Makmal）进行，那里有一个中国投资者参与投资的金矿。奥索耶夫表示，按计划将马上展开地质勘测，明年3月完成可行性研究。

中国国家主席习近平已对该项目表示支持。他出访了哈萨克斯坦，停留一天后到乌兹别克斯坦参加撒马尔罕的峰会，这是他自新冠疫情暴发以来第一次出国访问。中国的专家在8月抵达吉尔吉斯斯坦。乌兹别克斯坦总统米尔济约耶夫也已表达了祝愿，称该项目将“把我们与亚太国家连接起来，为新的经济机会铺路”。至于俄罗斯，扎帕罗夫称他已经得到普京本人同意。7月，该计划得到俄罗斯为首的欧亚经济联盟（Eurasian Economic Union）的支持。

不少外国外交官和专家却表示怀疑。他们说这个项目已经太多次要动而未

动，而且普京的话也不可靠。他们指出吉尔吉斯斯坦政局不稳，欠中国大笔债务，反华情绪高涨。批评者还指出，中国的许多债务国都无力还贷，中国因此正在缩减“一带一路”基建项目。而且中国还需要把自己境内的铁路延伸160公里。

不过就连怀疑派也承认，最新的中吉乌铁路计划有着强劲的推动力。它主要来自中亚各国政府。它们希望借此提升与邻国的交通联系，避免日后受外来者控制。乌兹别克斯坦最卖力地摇旗呐喊。米尔济约耶夫目前处于强势地位。他在2016年苏联时代的独裁总统去世后上台，之后赢得了西方政府和国际机构的尊重。“乌兹别克斯坦是这一切的真正推手，无论是财力还是后勤方面。”位于吉尔吉斯斯坦首都比什凯克的研究机构欧安组织学院（OSCE Academy）的邱芷恩（Niva Yau）说。

米尔济约耶夫还将在撒马尔罕峰会上力推另一个铁路项目：一条经阿富汗连接乌兹别克斯坦和巴基斯坦的铁路线。目前已有一条从乌兹别克边境到阿富汗北部的马扎里沙里夫（Mazar-i-Sharif）的短线铁路。新铁路线将其延长573公里，经喀布尔到达巴基斯坦的白沙瓦（Peshawar），连接当地由英国在19世纪末建造的铁路设施。地处内陆的乌兹别克斯坦和阿富汗可以通过巴基斯坦的港口更快捷、廉价地开展海运。支持者估计，该铁路项目将使乌兹别克斯坦到巴基斯坦的货运耗时从35天缩短到四天左右。巴基斯坦和阿富汗可从中赚取过境费。中国将巴基斯坦的瓜达尔港打造为航运枢纽的计划会因而得到助力。中国在喀布尔附近投资的一个铜矿也能获得一条新出口路线。

建一条跨阿富汗的铁路的想法出现得比建跨吉尔吉斯的铁路要早。俄罗斯和英国在上世纪初就开始考虑了。伊朗和苏联在上世纪70年代构想过。2001年美国带头入侵阿富汗后，西方国家也有这个想法。人们熟知的那些障碍始终存在：地形险峻、安全风险，还有商业可行性成疑。“你能想象在无法完全掌控政局的情况下修建一条穿越阿富汗的铁路吗？”智库卡内基国际和平基金会（Carnegie Endowment for International Peace）的马铁木（Temur Umarov）质疑说。世界银行在2012年就以巴基斯坦铁路的状况为鉴，反对建造一条类似的铁路。

但现在塔利班掌权，他们支持建这条铁路。新安全隐患来自“伊斯兰国”在阿富汗的分支。阿富汗和乌兹别克当局正联手处理这个问题并创造新的经济机会。自2012年以来，中国已在巴基斯坦投资百亿美元兴建基础设施。许多项目已经陷入停滞，而拟建的跨阿富汗铁路能重新激活这些项目，特别是如果其他国家和多边贷款机构能参与进来的话。乌兹别克、阿富汗和巴基斯坦的官员们表示已请求世界银行及其他贷款机构提供支持。

这两条铁路的命运可能都取决于能否吸引到除中国以外的资金。“一带一路”项目的问题已经使得中国对单独为基建项目提供资金态度谨慎。所以跨阿富汗铁路项目看起来比跨吉尔吉斯铁路更不牢靠，因为美国及其盟友都拒绝与塔利班政府打交道。两个项目最后都很可能落空。但哪怕有一条能建成，都会让该地区在更紧密地连接世界、更少依赖俄罗斯的道路上迈进一大步。■



Post-crash cryptocurrencies

The future of crypto is at stake in Ethereum's switch

Can decentralised networks reform themselves?

IT IS 2PM Universal Coordinated Time (UTC) on August 18th and all over the world people are dialling in to a fortnightly “core developers” Zoom call, which is broadcast live on YouTube to anyone who wants to watch. None of the participants have their cameras on. Most appear as just black squares with names—including one labelled Vitalik, behind which lurks Vitalik Buterin, the inventor of Ethereum.

A handful of users have adopted a panda avatar, with cartoon faces swaying and smiling in time to their human counterparts. That they picked the monochrome bear is thanks to Hsiao Wei Wang, an Ethereum researcher, who created a meme showing two bears, one black and one white, doing the “fusion dance” from “Dragon Ball Z”, a popular anime show. In the show the dance fuses two creatures into a single, stronger one. The panda—a combination of the two bears—has since become a symbol for “the merge”.

The merge is the name the crypto-community has given to the point at which the Ethereum blockchain will transition from using “proof-of-work” as a consensus mechanism—the method by which all the computers maintaining a blockchain agree to add new transactions to it—to using “proof-of-stake”. They call it the merge because, for almost two years, a separate proof-of-stake blockchain, called the Beacon chain, has been running alongside the original Ethereum one for developers to test, improve and test again. The Zoom call is for the developers to agree on when the two chains will join together. The date and time of the event will depend on how much computer power is being used to maintain the blockchain, but should happen at around 1am UTC on September 15th.

This is no mere technical tweak. It is a complete overhaul of a \$200bn software project that has been running for seven years, which will, if all goes to plan, be implemented with no downtime. People in crypto compare the process to changing the engine of an aeroplane mid-flight. Proof-of-work is hugely energy intensive, requiring vast amounts of computing power, and has resulted in blockchains, such as Ethereum and Bitcoin, consuming as much energy as small countries. Proof-of-stake will require 99.9% less energy to operate. The effect on emissions will be as though, overnight, Chile had been switched off (see chart 1). More important still, the merge will, if successful, show that Ethereum has the capacity for self-improvement, opening the door to more sweeping changes.

Crypto is in need of good news, for the past year has been a torrid one. A handful of dodgy deposit-taking ventures have gone bust, wiping out savings; a crypto hedge fund has blown up; a stablecoin was revealed to be anything but stable. The total market capitalisation of crypto has crashed to around \$1trn, about \$2trn lower than it was this time last year. Ethereum's improvements would not unpick any of this destruction. But, by reducing crypto's environmental impact and highlighting the potential for future improvements, it would suggest that it has a brighter future than many now appreciate.

The idea for the Ethereum blockchain was first published in 2014 by Mr Buterin. As with Bitcoin, it is a large database of all the transactions that have ever taken place in the cryptocurrency. But Mr Buterin's crucial insight was that the blockchain could do much more than that—it could also keep track of lines of code. This allows Ethereum to record transfers of the currency, but also of all the assets and functions that are maintained in “smart contracts”, self-executing agreements in which a chain of actions follows when certain conditions are met. This capability has made it possible for developers to build a large network of financial institutions, such as exchanges and lenders, in code on the Ethereum blockchain.

The blockchain is maintained by about a dozen pieces of software, called “clients”, that are worked on by the core developers. These are built in a variety of programming languages, including Go, Rust, Java and C#, and the software is run by the “nodes”—computers that run the client software to maintain the history of the Ethereum blockchain. All decisions about what to do, and whether upgrades will be implemented, are made by a consensus among developers, people who hold ether, the native token of the Ethereum blockchain, and people who have built applications on top of Ethereum or listed real-world assets on the blockchain. Any plans and code are published in real time on GitHub, a repository for programmers. The core developers meet, as pandas or otherwise, to discuss potential upgrades every two weeks. Anyone can in theory become a core developer just by working on the software.

The result is that developers are a rag-tag bunch. Some are employed by firms like ConsenSys, a Brooklyn-based blockchain-software outfit established by Joe Lubin, one of the handful of people who helped found Ethereum after Mr Buterin’s white paper in 2014. Some are employed by the Ethereum Foundation, a non-profit organisation set up in Zug, Switzerland, in 2014 with the proceeds of the sale of ether tokens. Others are hobbyists incentivised to help out because they hold tokens. At least 122 developers in 30 countries have worked on the merge software.

Ethereum is not a company, and Mr Buterin, for all his clout and importance as its creator, is not its chief executive. It is open-source—much like Linux, an operating system, and Firefox, a web browser—but the ability to buy a stake in its success, through ether tokens, provides an incentive to get involved in maintenance. The extent to which governance is truly decentralised is not entirely clear. In a recent interview with Noah Smith, an economics blogger, Mr Buterin said that, at the start of the project in 2015, he was doing most of the research and thinking about what Ethereum should be, as well as a lot of the coding to make it a reality.

By 2020 he was doing perhaps only a third of the research, very little coding, but most of the “high-level theorising”. In the past two years, he said, even the high-level theory “has been slowly but surely slipping away from me”.

To implement a change like the merge requires sufficient consensus among the interested parties. All the major clients must be rewritten to use the new code, enough nodes must update their software and all the applications layered on the blockchain—like stablecoins backed by dollars in bank accounts—must accept the new merged chain is the one that will maintain the status of their assets. It can be surreal to watch in real time. It is as if *The Economist* started to live stream its editorial meetings and allowed subscribers to commission articles and select covers.

| *The miners strike*

Nor are all the interested parties in favour of the merge. Miners have invested as much as \$5bn in hardware to run the proof-of-work consensus mechanism. On September 15th or thereabouts that hardware will no longer earn them much of a return. The way proof-of-work maintains the security of a blockchain is by incentivising hundreds of thousands of computers to solve a mathematical puzzle. The computer that first finds a solution alerts the other miners and, if they confirm the result, updates the blockchain and is paid. As such it pays, in lovely, freshly minted ether, to have lots of mining hardware.

Proof-of-stake makes decisions about updating the blockchain by a vote among the holders of a cryptocurrency. Voting power, as well as the share of the rewards, depends on how much ether has been staked. If stakers misbehave, such as by putting through faulty transactions, their stake can be destroyed. Thus on September 15th the advantage of having lots of mining hardware will disappear. Instead, the advantage will be in holding ether.

Miners could attempt to put off the merge by revolting. But the nodes appear to be mostly going along with the update. According to ethernode, a website that tracks Ethereum activity, around 75% have updated their software to be ready. The alternative is to attempt to “fork” the blockchain, by still running the old software and hoping that enough others do the same that the old version of the blockchain will continue to exist. A dispute over a hack in 2016 led to Ethereum splitting into two chains: Ethereum (the dominant one) and “Ethereum Classic” (a much smaller one).

For a split this time, “there basically needs to be one single miner in the world who decides they want to continue with the proof of work,” meaning there almost certainly will be one, says Justin Drake of the Ethereum Foundation. The question is how many miners stick and how many twist. Chandler Guo, who supported the Ethereum Classic fork in 2016, is attempting to organise miners around a proof-of-work token called “ETHW”. “I fork Ethereum once, I will fork it again!” he has said. Although the miners have reason to stay with the old way of doing things, the economics of trying a forked chain will probably not add up. It will only make sense to mine ETHW if the value of the token is worth enough. And a version of Ethereum minus DeFi apps, stablecoins and developers is probably not worth very much.

Institutions such as Circle, a stablecoin operator, have thrown their weight behind the new approach, rather than any forks. In a statement on August 9th the firm said that it “intends to fully and solely support the Ethereum proof-of-stake chain post-merge”. Wallet operators and exchanges are also backing the proof-of-stake chain.

These dynamics reveal the balance of power inherent in Ethereum. The developers cannot put through updates that are universally hated, because doing so would cause a messy fork; the miners cannot resist an update if everyone else supports it. The decisions made by those that run

applications on top of the blockchain, like Circle, can help solve disputes between the camps. This is very different from traditional tech platforms. Apple can push through an update that neither iPhone users nor app developers like, and there is little either group can do about it short of ditching iPhones altogether. There is no such thing as a “forked” iPhone.

The way Ethereum gets to a consensus is “kind of a messy and ad-hoc process”, admits Mr Drake. But there are enormous benefits if things go well. The impact of the overnight elimination of its energy needs will be thinly spread as Ethereum is mined all over the world. Almost half the nodes are in America; around a tenth are in Germany. Other countries, like Singapore, Britain and Finland, are home to less than 5%. But in smaller countries where mining is disproportionately popular, like Singapore, it is possible energy prices could fall.

The change also reduces the need for mining hardware. Nvidia, a chipmaker, makes graphics cards for gaming that can also be used for mining ether. From May to July, in part fuelled by rumours of an impending merge, revenues from its chips fell by almost half compared with the previous three months. On eBay prices of second-hand graphic cards are tumbling.

Since the network will no longer need so much energy and hardware to maintain it, rewards for validating transactions can be reduced. “With proof of work the scarce resource offered in return for rewards is computing power. That is very expensive because you have to pay for electricity bills and you have to cover hardware costs,” notes Mr Drake. With proof of stake, the scarce resource is instead digital money. “So the maintenance cost is essentially the opportunity cost of that money, which is maybe 3% or 4%.” Thus Ethereum will pay out just 10% as many tokens per block validated by stakers post-merge as it did to miners before it.

This change in the monetary system is probably one reason why, since the timing of the merge began to firm up in mid-July, ether prices have jumped. The currency has climbed by almost 50%, even as bitcoin and other crypto tokens have traded sideways (see chart 2). Ethereum's boosters think a successful merge could pave the way for "the flipping", when the market capitalisation of ether surpasses that of bitcoin for the first time. It is currently about half as valuable as its rival cryptocurrency, which is close to its highest share since 2017.

The other big benefit is security. At the moment, to take control of the Bitcoin or Ethereum blockchain an attacker needs 51% of the total computing power used to mine the currency. Rough estimates put the cost of this at \$5bn-10bn. To attack a proof-of-stake blockchain would require buying up and staking half of all tokens, which would currently cost around \$20bn.

Some think these benefits will come at the cost of centralising power, since under proof-of-stake big holders reap more rewards, increasing their holdings further. But, says Ben Edgington of ConsenSys, the blockchain-software firm, this argument is wrong-headed. Small stakes will earn less than big stakes, but they will hold the same percentage of total outstanding tokens through time, meaning their relative power will not increase. With proof-of-work there are also returns to scale from building huge mining rigs, which are more efficient. "There is no way someone could set up a competitive at-home mining rig," notes Mr Edgington.

| *Blocking progress*

Another risk is that the transition fails in some way, which could undermine public support. Mr Lubin, Ethereum's co-founder, is unperturbed. He says "there has just been so much testing that I think the blockchain elements will go perfectly smoothly." The only potential missing link in the transition, Mr Edgington thinks, is the wider

community. Given the complications in installing new components, and the need to get to grips with a new way of working, some participants may be lost. But there will only be problems if more than 40% are, and that is unlikely, he says. Applications, such as exchanges, that run on top of the blockchain may, though, experience some hiccups. Major software updates reveal all kinds of bugs in previously sound-looking code. Important DeFi apps, like Aave, a lending platform, are readying themselves by suspending transactions in ether over the merge period.

If all goes smoothly, the merge will be a step towards a much more useful technology. Many of the financial applications that operate on top of the blockchain are extremely efficient, in part because they automate the functions of a financial system. Smart contracts automatically match buyers and sellers or borrowers and lenders at an exchange. An IMF paper found that the marginal costs of financial intermediation by DeFi apps were about a third as much as rich-country banks and a fifth of emerging-market banks. But the efficiency for users is hampered by how slow and expensive using the Ethereum blockchain can be. At times when the network is busy the charges to have transactions recorded, called “gas fees”, can spike to as much as \$100 for a single transaction.

Upgrades after the merge are mostly aimed at improving scale and efficiency. In July, at an Ethereum conference in Paris, Mr Buterin joked that the path for the blockchain is first to “merge”, and then “surge”, “verge”, “purge” and “splurge.” The surge, next on the list, refers to “sharding”, which is the process of splitting a database into pieces to spread the load. This will allow the blockchain to process many more transactions and should reduce the fees required to use it. “Ethereum today can process about 15-20 transactions a second. This Ethereum...it’s going to be able to process 100,000 transactions a second,” Mr Buterin proclaimed.

The verge will implement a new kind of mathematical proof known as

“Verkle trees” and make “stateless clients” possible. That will mean someone can run the software to operate a node without having to store the entire “state” of the blockchain, an enormous amount of data. The purge will remove old data on the blockchain’s history. The splurge is “all of the other fun stuff”, which could be anything that Mr Buterin and the cryptoheads fancy. A successful merge is the first step on the path towards all of these changes. It would prove that decentralised groups of people can do risky, contentious and important things. Time to find out if they can. ■



崩盘后的加密货币

以太坊转型攸关加密货币的未来

去中心化网络能否自我改造？【深度】

协调世界时（UTC）8月18日下午两点，位于世界各地的人们接入每两周一次的“核心开发人员”Zoom视频会议。任何人可以在YouTube上收看直播。所有与会者都没有打开摄像头，他们多数都只显示为一个黑色方块和一个名字。其中一个方块署名Vitalik，以太坊的发明者维塔利克·布特林（Vitalik Buterin）隐藏其后。

少数用户选用了熊猫的虚拟化身，其卡通头像会实时跟随真人摇摆和微笑。他们之所以会选择这个黑白两色的熊科动物是因为以太坊研究员王筱维创建的一个表情包。这个表情包里有两只熊，一黑一白，跳着流行动画片《龙珠Z》（Dragon Ball Z）中的“融合舞”——在剧中两个人物跳着这种舞步合体为一个更强大的人物。在表情包中，两头熊合体为一只熊猫。此后熊猫就成了“合并”的标志物。

“合并”是加密货币社区对以太坊区块链将要发生的一次转型的称呼。以太坊将从使用“工作量证明”（proof-of-work, PoW）作为共识机制（即共同维护一个区块链的所有计算机同意往链上添加新交易的方法），转变为使用“权益证明”（proof-of-stake, PoS）。他们称之为“合并”，是因为近两年来一个独立的名为“信标链”（Beacon）的权益证明区块链一直与以太坊主网平行运行，供开发人员测试、改进和再测试。此次Zoom会议是为让开发人员就两条链的合并时间达成一致。具体日期和时间将取决于目前有多少算力被用于维护以太坊区块链，但应该会在UTC时间9月15日凌晨1点左右发生。

这不仅仅是一次技术调整。这是对一个已经运行了七年、价值2000亿美元的软件项目的彻底改造。如果一切按计划推进，那么改造将在不中断运行的情况下实施完成。币圈将此过程比作飞机在空中更换引擎。PoW是极度能源密集型的，需要巨量算力，导致以太坊和比特币等区块链的耗能堪

比一些小国家。PoS的运行将减少99.9%的耗能。这对排放的影响就好比整个智利一夜间被关停（见图表1）。更重要的是，如果合并成功，它将表明以太坊具有自我改进能力，为更多更彻底的变革打开了大门。

币圈需要好消息，因为过去的一年非常难熬。一批吸收客户存款的加密货币机构运作不良，接连倒闭，人们投入其中的储蓄灰飞烟灭。一只加密对冲基金申请破产；一种稳定币被证明根本不稳定。加密货币的总市值已暴跌至一万亿美元左右，比去年此时缩水了约二万亿美元。以太坊的改进无力挽回任何这种破坏。但是，通过减少加密货币对环境的影响并突显未来改进的潜力，它将表明它的未来会比现在许多人所认为的更加光明。

以太坊区块链的构思由布特林于2014年首次发表。和比特币一样，它是记录加密货币中曾经发生的所有交易的大型数据库。但布特林的关键洞见是，区块链可以做的远不止于此——它还可以追踪代码行。这使得以太坊不仅可以记录加密货币的转移，还可以记录保存在“智能合约”的所有资产和功能。“智能合约”是自动执行的协议，在某些条件被满足时会触发一连串操作。这种能力使得开发人员可以在以太坊区块链上用代码构建一个大型的金融机构网络，包含交易所和贷款机构等。

以太坊区块链由十来个名为“客户端”的软件维持运转，这些软件由核心开发人员开发和更新。它们用各种编程语言构建，包括Go、Rust、Java和C#等，并由“节点”运行。“节点”即运行客户端软件以保存以太坊区块链历史的计算机。所有关于要做什么以及是否实施升级的决定都由开发人员、以太币（以太坊区块链的原生代币）持有者，以及在以太坊之上构建了应用或绑定真实世界资产的人达成共识后做出。任何计划和代码都会实时发布在供程序员使用的存储库GitHub上。核心开发人员使用熊猫头像等化身隔周开一次会，讨论可能进行的升级。理论上任何人都可以通过写软件成为核心开发人员。

其结果是，开发人员是五花八门的一群人。有些人受雇于ConsenSys等公司。这是一家总部位于布鲁克林的区块链软件公司，创始人约瑟夫·鲁宾（Joe Lubin）是2014年布特林发表白皮书后帮助创建以太坊的一小撮人之

一。有些人在以太坊基金会（Ethereum Foundation）任职，这是一个用销售以太币所得于2014年在瑞士楚格成立的非盈利组织。其他人则是因为持有代币而有动力帮忙的业余爱好者。至少有位于30个国家的122名开发者参与了合并软件的开发。

以太坊不是一家公司。尽管作为它的创造者，布特林对它很有影响力、很重要，他也不是首席执行官。以太坊是开源的，这一点很像操作系统Linux和网络浏览器Firefox。但是，人们可以通过拥有以太币而从其成功中分红，于是就有了参与维护它的动力。其治理真正达到了怎样的去中心化程度并不完全清楚。近日在经济学博主诺亚·史密斯（Noah Smith）的采访中，布特林说，2015年这个项目刚启动时，基本上都是他自己在研究和思考以太坊应该是什么，并写了大量代码来实现它。到了2020年，他只负责了大概三分之一的研究，写了一点点代码，但做了大部分的“高层理论构建”。过去两年里，他说道，即便是高层理论“也已渐渐但明确地不归我管了”。

要实现像此次合并这样的变更，需要相关利益各方达成足够共识。所有主要客户端须改写以使用新代码；足够多的节点须更新其软件；所有铺设在区块链上的应用——比如受银行账户中的美元支撑的稳定币——须接受将由新的合并后区块链维护自己的资产现状。实时观看这一改变可能会有超现实感。这就好比本刊开始直播编辑会议了，还允许订阅用户委托采编文章和选定封面。

| 矿工罢工

也不是所有利益方都支持合并。矿工们已经在硬件上投入了高达50亿美元来运行PoW共识机制。从9月15日左右开始，这些硬件将不再为他们带来多大的回报。PoW维护区块链安全的方式是激励数十万台计算机解答一道数学题。首先找到答案的计算机即刻通告其他矿工，一旦它们确认结果，便更新区块链并领取报酬。因此，拥有大量挖矿硬件是值得的——这能赚到迷人的、新鲜铸造的以太币。

PoS则通过加密货币持有者投票来做出更新区块链的决策。投票权以及奖

励份额取决于质押了多少以太币。如果质押者行为不端，例如给有问题的交易放行，其质押可能会遭销毁。因此，到了9月15日，拥有大量挖矿硬件的优势将消失，取而代之的是持有以太币的优势。

矿工可能试图造反来延阻合并。但目前大部分节点似乎都赞同这项升级。据追踪以太坊活动的网站ethernode的数据，大约75%的节点已经更新了软件以做好准备。另一种反抗是尝试“分叉”区块链，也就是继续运行旧软件并寄希望有足够多其他节点也这么做，以使旧版本区块链继续存在下去。2016年因一次黑客攻击引发的争议导致以太坊分裂成两条链：以太坊（主导链）和“以太坊经典”（Ethereum Classic，一条规模小得多的链）。

以太坊基金会的贾斯汀·德雷克（Justin Drake）表示，如果这一次要分叉，“基本上全世界只要有一个矿工决定他想继续使用PoW就够了”，这就意味着几乎肯定会有这么一个矿工。问题是有多多少矿工坚持使用旧机制，而有多少会改道。2016年支持“以太坊经典”分叉的郭宏才正试图围绕名为“ETHW”的PoW代币组织矿工。“我分叉过一次以太坊，我将再次分叉它！”他这样说过。尽管矿工们有理由继续使用旧模式，尝试一条分叉链在经济上可能并不合算。只有当ETHW的价值足够高时，挖掘它才有意义。而一版没有了DeFi应用、各种稳定币和开发者的以太坊多半不大值钱。

诸如稳定币运营商Circle之类的机构都已全力支持新模式而非任何分叉。该公司在8月9日的一份声明中表示，它“打算在合并后完全支持并且只支持以太坊权益证明链”。各种钱包运营商和交易所也在支持PoS链。

这些动态揭示了以太坊固有的力量平衡。开发人员不能执行被普遍反对的升级，因为这会导致混乱的分叉；而如果其他人都支持一项升级，矿工们就无法阻挡它。那些在区块链上运行应用的机构（如Circle）所做的决定有助于解决不同阵营间的纠纷。这和传统的技术平台有很大的不同。苹果公司可以推出iPhone用户和应用开发人员都不喜欢的升级，而这两方对此都无计可施，除非完全弃用iPhone。不存在“分叉的”iPhone这样东西。

德雷克承认，以太坊达成共识的方式是“一种混乱而无计划的过程”。但如

果事情进展顺利，就会有巨大的益处。由于以太坊挖矿在世界各地进行，其能源需求在一夜之间消失的影响将被摊得很薄。近一半节点在美国；约十分之一在德国。其他国家，如新加坡、英国和芬兰，拥有不到5%。但在新加坡这样挖矿异常流行的小国家，能源价格可能会随之下跌。

此次变化还减少了对挖矿硬件的需求。芯片制造商英伟达（Nvidia）生产用于游戏的显卡也可用于开采以太币。从5月到7月，一定程度上受以太坊即将合并的传言影响，其芯片收入与前三个月相比下降了近一半。在eBay上，二手显卡的价格正在暴跌。

由于这一网络将不再需要那么多能源和硬件来维护，验证交易的奖励可以因此减少。“在PoW机制下，为获得回报而提供的稀缺资源是算力。它是非常昂贵的，因为你必须支付电费和硬件成本。”德雷克指出。在PoS机制下，稀缺资源变成了数字货币。“所以维护成本实质上是这笔钱的机会成本，可能是3%或4%。”因此在合并后，以太坊为每个被验证区块支付的代币数量将仅是从前向矿工支付数量的10%。

该货币系统的这种变化可能是自7月中旬合并的时机开始确定以来以太币价格大涨的原因之一。在比特币和其他加密货币横向波动之时，以太币上涨了近50%（见图2）。以太坊的支持者认为，此次合并成功可为“大反转”——也就是以太币的市值首次超过比特币——铺平道路。它目前的市值约为其竞争对手货币的一半，接近2017年以来的最高比例。

另一大好处是安全性。目前，要控制比特币或以太坊区块链，攻击者需要拥有挖矿总算力的51%。粗略估计这一成本在50亿到100亿美元。要攻击PoS区块链将需要购入并抵押代币总数的一半，以目前的价格计需要耗费200亿美元左右。

一些人认为这些好处将以权力的集中为代价，因为在PoS机制下，大股东会获得更多回报，进一步增加其持股量。但是，区块链软件公司ConsenSys的本·埃丁顿（Ben Edgington）说，这种说法是错误的。小股权的收益将少于大股权，但随着时间推移，大股权持有的未偿代币的比例

并没有改变，意味着它们的相对权力不会增长。在PoW机制下，建造更高效的巨型挖矿设备还带来了规模收益。“你不可能部署一套有竞争力的家庭挖矿机。”埃丁顿指出。

| 区块进展

另一个风险是此次转型以某种方式失败，这可能会削弱公众支持。以太坊的联合创始人鲁宾对此全不担心。他说：“已经做了那么多测试，我认为区块链相关元素不会有任何问题。”埃丁顿认为转型中唯一可能缺失的环节是更广泛的社区。鉴于安装新组件的复杂性，加之需要掌握新的工作方式，一些参与者可能会不知所措。但只有超过四成人都这样才会出现问题，他说，而这不大可能。但是，在区块链上运行的应用（如交易所）可能会遇到一些小问题。大型软件升级会暴露出此前看起来非常健全可靠的代码中各种各样的漏洞。一些重要的DeFi应用，比如借贷平台Aave，纷纷在合并前夕暂停以太币交易来做好准备。

如果一切顺利，合并将是朝着让这项技术用途大增迈出的一步。许多在区块链上运行的金融应用都极为高效，部分原因是它们让一个金融系统的功能自动化了。智能合约在交易所中自动匹配买卖或借贷双方。IMF的一篇文章发现，DeFi应用充当金融中介的边际成本约为发达国家银行的三分之一，新兴市场银行的五分之一。但是，使用以太坊区块链有时非常耗时和昂贵，拖累了它对用户的效率。在这个网络繁忙之时，让系统记录交易的费用（称为“gas费”）有时会飙升至单笔交易100美元。

合并之后的升级主要是为提升规模和效率。7月，在巴黎举行的一次以太坊会议上，布特林开玩笑说，以太坊区块链要走的路径首先是“合并”，然后是“激增”、“边缘”、“清除”和“挥霍”。这个步骤中的下一项“激增”指的是“分片”，是把一个数据库拆成碎片以分散负载的过程。这将使得该区块链能处理的交易量大增，并且应该会减少使用它所需的费用。“今天的以太坊每秒可处理大概15到20笔交易。这个以太坊.....它将能够每秒处理10万笔交易。”布特林宣称。

“边缘”将实施一种名为“沃克尔树”（Verkle tree）的新型数学证明，并实现

“无状态客户端”。这意味着某个人可以运行该软件来操作一个节点，却无需存储区块链的整个“状态”也就是海量的数据。“清除”将删除区块链历史上的旧数据。挥霍是“所有其他有趣的东西”，可能是布特林和加密迷们幻想的任何东西。成功的合并是迈向所有这些变化的第一步。它将证明分散化的人群可以做有风险、有争议和重要的事。很快要见分晓了。■



Powerful prices

Vast corporate profits are delaying an American recession

Strong pricing power for firms makes the economy more resilient

TO THE EARS of many, “pricing power” is something of a dirty term. For left-wingers it conjures up images of greedy corporations abusing their market dominance to charge more. For economists it raises the spectre of sticky inflation as companies ratchet up prices to cover higher costs. But from another perspective, pricing power is less of a problem: it enables firms to withstand the kind of inflationary pressures that they are now experiencing. In so doing, it serves as a shock absorber for the economy, forestalling the risk of a recession.

The past few weeks have put pricing power in the spotlight in America. According to data published on August 25th, post-tax corporate profits reached 12.1% of GDP in the second quarter, their highest since at least the 1940s (see chart). When companies announced their second-quarter results, dozens noted their capacity to raise prices in the face of higher wages and dearer inputs. Chipotle, a fast-food chain, emphasised that it had sold more expensive burritos to its relatively affluent customers. The boss of Hilton boasted that, having raised room rates sharply in the face of strong demand, the hotel chain was set for “the biggest summer” in its century-long history. At IBM, a tech giant, an executive reported that the company was at last “starting to capture the reality” of higher costs in its pricing.

The combined effect of all these individual corporate decisions is striking. Nearly three-quarters of companies in the S&P 500, America’s main stock index, beat earnings estimates in the second quarter. Overall, their net profit margins were roughly 12%, a touch lower than in the same quarter last year but still above their five-year average of 11%. That helps explain the

rally in stockmarkets that got going in mid-June. It also adds to the evidence that, despite all the gloomy talk, America's economy is in reasonably good shape—and is not in recession.

If there were a compression in margins, it would portend a downswing in the business cycle. Facing lower profits, companies are forced to find ways to cut costs, which often include firing workers. When sufficient numbers do that, it becomes a drag on the rest of the economy. Conversely, comfortable margins suggest less cost-cutting pressure. Thus the corporate results of the past couple of months are squarely on the side of resilience.

Why are companies doing so well? Unsurprisingly, energy firms have led the pack, benefiting from the surge in oil and gas prices that followed Russia's invasion of Ukraine in February. Revenues for the S&P 500, including energy companies, were up by nearly 14% in the second quarter compared with a year ago. Excluding energy companies, they were up by 9%, according to FactSet, a data provider.

Nevertheless, even allowing for the outperformance of the energy sector, profitability has been impressive. Part of the explanation may be that American companies have more market power than a few decades ago, bringing greater stability to their earnings. Laxer application of anti-monopoly laws over the years as well as the return-to-scale of big-tech platforms help account for that.

Yet the robustness of profits over the past year is down to something far more basic: the rude health of both consumers' and companies' balance-sheets. In nominal terms, final demand has been well above its pre-pandemic trend, fuelled by several rounds of stimulus.

The question is how long the good times will last. Pessimism is building as the Federal Reserve raises interest rates to combat inflation. In July a survey

of chief financial officers by UBS, a bank, found that they were more downbeat about their pricing power over the next 12 to 24 months than they had been in January. Some companies are already cutting back their capital-spending plans, which could spill over into hiring, too.

But this is all being done from a position of considerable strength. Aneta Markowska, an economist at Jefferies, another bank, says the Fed may ultimately be forced to induce a recession to curb inflation, but adds that it will have a fight on its hands, in part because of the resilience of profit margins. “It’s like a Mike Tyson economy,” she explains. “It’s a lot stronger than you think, and it’s going to take a lot of work to take it down.” ■



强劲价格

巨额公司利润正在延缓美国经济衰退

公司强大的定价能力让经济更具韧性

“定价能力”在许多人听来不是个好词。左翼人士的头脑里出现了贪婪的公司，它们滥用自己的市场主导地位来提高收费。经济学家想到了可怕的粘性通胀，它因公司提高价格以贴补更高的成本而引发。但从另一个角度来看，定价能力却没有那么糟糕，它让公司能够承受住像它们眼下正在承受的那种通胀压力。在此过程中，它充当了经济的减震器，阻止衰退的发生。

过去几周，定价能力在美国引起了广泛关注。根据8月25日公布的数据，第二季度企业税后利润达到GDP的12.1%，至少是自上世纪40年代以来的最高水平（见图表）。一众企业公布第二季度业绩时，有几十家公司提到自己在工资上升和投入品涨价之时有能力提高价格。快餐连锁店Chipotle强调，涨价后的墨西哥卷饼在较富裕客户中的销量增加了。连锁酒店希尔顿的老板夸耀说，面对强劲的需求，酒店大幅提高了房价，将迎来其百年历史上“最火爆的夏天”。科技巨头IBM的一位高管报告称公司终于在其定价中“开始反映（成本上涨的）现实”。

所有这些公司的决策综合起来影响惊人。在美国主要股指标普500指数中，近四分之三的公司第二季度盈利超过预期。总体而言，它们的净利润率约为12%，略低于去年同期，但仍高于11%的五年平均水平。这有助于解释6月中旬的股市反弹。它还进一步证明，尽管有各种令人沮丧的言论，但美国的经济状况相当不错，并未陷入衰退。

如果利润率受挤压，则会预示商业周期将出现下行。面对利润降低，公司会不得不想办法削减成本，通常会涉及裁员。当这么做的公司达到一定数量时，就会拖累经济的其他部分。相反，利润率水平令人满意则表明削减成本的压力较小。因此，过去几个月的公司业绩完全体现了经济的韧性。

公司业绩为什么这么好？不出所料的是，受益于2月俄罗斯入侵乌克兰后石油和天然气价格的飙升，能源公司在其中领跑。包括能源公司在内的标普500指数公司的收入在第二季度同比增长了近14%。据数据供应商FactSet称，如果不包括能源公司，涨幅为9%。

尽管如此，即使考虑到能源板块有超出整体的表现，公司的盈利情况也相当不俗。部分原因可能是美国公司的市场支配力比几十年前更强，令它们的收益更能保持稳定。近年反垄断法的实施较为宽松，大型科技平台享受着规模收益，有助于解释这种支配力。

不过，过去一年的强劲利润表现可以归结为更基本的因素：消费者和企业的财务状况都很健康。在几轮刺激措施的推动下，按名义价值计算，最终需求远高于疫情前的趋势。

问题是好光景能持续多久。随着美联储加息对抗通胀，悲观情绪正在累积。7月，瑞银对首席财务官的一项调查发现，与1月时相比，他们对未来12至24个月的定价能力要更悲观。一些公司已经在缩减资本支出计划，这也可能影响到招聘。

但这一切都是在经济相当强劲的情况下发生的。另一家银行杰富瑞的经济学家阿妮塔·马考斯卡（Aneta Markowska）表示，美联储最终可能被迫诱发衰退以抑制通胀，但她补充说，美联储将面临一场硬战，原因之一是利润率的韧性。“现在的经济就像拳王泰森一样，”她解释道，“它比你想象的要强大得多，要使出很大的力气才能把它打趴下。”■



Zoom fatigue

The tech winners and losers of the pandemic

As Zoom and friends tumble, the software that underpins daily life thrives

IN THE EARLY days of covid-19, the tech industry was consumed by a sense of euphoria. With billions of people locked down at home, work and play were shifting online. Many hoped that the new normal would spark a huge productivity boom as firms digitised and workers spent less time commuting. The excitement was most evident in stockmarkets, where any firm related to this trend saw its share price surge. The value of an equally weighted portfolio of five pandemic darlings—call it the “lockdown lunacy index”—increased by 320% from the start of the pandemic to its peak in August 2021. The tech-heavy NASDAQ, by contrast, rose by 88%.

The mania has ended. Today the lockdown lunacy index—which includes Netflix, a streaming service; Peloton, a maker of fancy exercise bikes; Robinhood, a stock-trading app; Shopify, an e-commerce platform; and Zoom, a videoconferencing firm—has fallen by more than 80% from its peak, far exceeding the 18% drop in the NASDAQ. Zoom and friends are trading at below pre-pandemic prices.

How worrying is this return to Earth? To be sure, some of it reflects gloomier prospects for the global economy, racked by inflation, war and rising interest rates. And it is disappointing that two years of digitisation and remote work have not provided clear evidence of a productivity boom. Yet there are reasons still to be techno-optimistic. Much of the early enthusiasm may simply have been focused on the wrong types of firm. Though the pandemic darlings have fizzled, the shift towards ever greater digitisation continues. The true winners are not the flashy consumer-tech firms, but the companies that provide the infrastructure to enable this shift.

Much of the decline of our lockdown index reflects shakier business models. On August 22nd Zoom reported that its year-on-year revenue growth had fallen to 8%, the lowest rate since the company listed in 2019. Three days later Peloton reported a nearly 30% fall in its quarterly sales, compared with a year ago. Subscribers are fleeing Netflix for other viewing platforms, such as Disney+. Robinhood is laying off a quarter of its staff as day traders cool on the markets.

The fading work-from-home boom has affected the demand for hardware, too. Worldwide PC shipments are expected to decline by 10% this year; analysts reckon mobile-phone sales will tumble by 7%. A downturn in spending on video games and a series of crypto implosions have dented the sales of the powerful semiconductors used to mine digital currencies and render computer graphics.

Look beyond the boom and bust of consumer tech, though, and you see the real successes. The market for the infrastructure technology that underpins people's daily lives, such as cloud computing, cybersecurity and digital payments, is thriving. The cloud-computing industry is expected to grow to almost \$500bn this year, up from \$243bn in 2019. Amazon's cloud offering, the largest in the world, is still growing at 33% each year. It accounted for three-quarters of the firm's operating income over the past 12 months, and is propping up the tech giant's ailing e-commerce business. Its closest rivals are the cloud services of Microsoft and Google. Their annual sales are growing by 40% and 36%, respectively.

Cloudification has created new demands for cybersecurity, another tech winner. The combined revenue at the three largest listed cybersecurity firms has almost doubled since the start of the pandemic. Their market capitalisation has tripled, and has come down only a fraction since the start of the year. Digital payments are another bright spot, thanks to lockdowns and social distancing. Three-quarters of iPhone owners use Apple Pay, up

from half in 2019, and nine out of ten American retailers now accept it as a payment method. Almost 200 million people in India and China have used some form of digital payment for the first time since the onset of covid. A third of adults in sub-Saharan Africa now have a mobile-money account, up from a fifth in 2017.

| *Sanity reigns*

The bubble may have burst on the pandemic's darlings, but the drumbeat of digitisation continues. The less eye-catching technologies that provide the underlying infrastructure for the shift are the true beneficiaries of covid. Whether these will fuel a productivity boost one day remains to be seen. But there was more going on during the pandemic than lockdown lunacy.





【首文】Zoom疲劳

疫情中的技术赢家和输家

当Zoom和它的小伙伴们暴跌时，支撑日常生活的软件蓬勃发展

疫情爆发初期，科技行业沉浸在一种欣快感中。数十亿人被困家中，工作和娱乐都转移到了网上。许多人希望，随着企业走向数字化和员工通勤时间减少，这种新常态将引发生产率的巨大提升。这种兴奋情绪在股市中表现得最为明显，任何与这一趋势相关联的公司都股价大涨。如果把疫情期间的五大宠儿公司按同等权重构成一个投资组合——就叫它“封锁癫狂指数”吧，那么该指数从疫情爆发之初到2021年8月的高峰上涨了320%。相比之下，以科技股为主的纳斯达克指数上涨了88%。

这股狂热已经褪去。今天的“封锁癫狂指数”——它包括流媒体服务奈飞、高档健身自行车制造商Peloton、股票交易应用Robinhood、电商平台Shopify和视频会议公司Zoom——已经从最高点下跌了80%以上，远远超过纳斯达克指数18%的跌幅。目前Zoom和它的小伙伴们股价比疫情前还低。

这次股价回落有多令人担忧？可以肯定的是，它在一定程度上是全球经济饱受通胀、战争和利率上升折磨而前景更显黯淡的反映。此外，两年的数字化进程和远程工作并没有显示出让生产率激增的明确证据，令人失望。不过，仍然有理由对技术持乐观态度。早期的那股热情可能只是没有聚焦在正确的那类公司上。虽然疫情期间的热点冷却，但向更大规模数字化的转变仍在继续。真正的赢家不是时髦光鲜的消费科技公司，而是为这种转变提供基础设施的公司。

我们这个封锁指数的下跌很大程度上反映了商业模式的不稳定。8月22日，Zoom报告称其收入同比增长已降至8%，这是该公司自2019年上市以来的最低增速。三天后，Peloton公布其季度销售额同比下降了近30%。订阅用户正在逃离奈飞，转向Disney+等观看平台。随着日内交易员在市场上降温，Robinhood正计划裁减四分之一的员工。

居家办公热潮的消退也影响了对硬件的需求。今年全球个人电脑出货量预计将下降10%；分析人士认为手机销量将下降7%。电子游戏支出下滑，以及加密货币频频暴雷，都影响了用于数字货币挖矿和计算机图形渲染的高性能芯片的销售。

不过，越过消费型科技的起起伏伏，你能看到真正的成功。云计算、网络安全和数字支付等支撑人们日常生活的基础设施技术市场正在蓬勃发展。今年，云计算行业预计将增长至近5000亿美元，而在2019年为2430亿美元。亚马逊的云服务为全球最大，仍在以每年33%的速度增长。在过去的12个月里，云服务占到这家科技巨头营业收入的四分之三，并支撑着它境况不佳的电商业务。它最接近的对手是微软和谷歌的云服务。这二者的年销售额分别增长了40%和36%。

向云端转移产生了对网络安全的新需求，这是另一个技术赢家。自疫情暴发以来，三家最大的上市网络安全公司的总收入已经接近翻番。它们的市值增长了两倍，自今年年初以来仅略有下降。因为封控和社交隔离，数字支付成了另一个亮点。现在四分之三的iPhone用户使用Apple Pay，2019年的比例是一半；美国九成零售商现在接受Apple Pay支付。自疫情暴发以来，印度和中国有近2亿人首次使用了某种形式的数字支付。撒哈拉以南非洲地区目前有三分之一的成年人拥有移动货币账户，高于2017年的五分之一。

| 理智是王道

疫情期间大热的公司可能已经泡沫破灭，但数字化的鼓点并未停歇。那些不那么引人注目的技术为这一转变提供了基础设施，它们才是疫情真正的受益者。这些是否会在某一天促进生产率提升还有待观察。但疫情期间发生的事并不只有“封锁癫狂”。■



Daughters of the soil

Young Koreans are moving to the countryside to farm

The government is encouraging them, hoping for rural rejuvenation

WHEN KIM JI-UN lived in Seoul, she worried about finding a good job and a decent place to live. Now, she frets that drought may botch her crop of potatoes and corn. The 23-year-old and her sister started a farm last year in Nonsan, a city in South Chungcheong province. Her first harvest was a success; she was surprised that her black soybeans did better than her strawberries.

Ms Kim is part of a phenomenon called kwichon, or returning to rural life. Coined a millennium ago, the term crops up during periods of economic hardship, when city-dwellers are forced to move back to their hometowns, often to farm. This time, in the wake of the pandemic, many new farmers such as Ms Kim have never lived in the countryside before. The government encourages them. It agitates over South Koreans' tendency to flock to Seoul, the capital, and sees kwichon as a way to revive dwindling rural areas. By planting young farmers in rural areas now, the government hopes to reap big rewards in future.

The plan is working. In 2021 nearly 380,000 people moved to the countryside, up 15% from 2015. Almost half of them (a record high) were younger than 40. The new generation cares less than earlier ones did about getting a job at one of South Korea's prestigious chaebol, such as Hyundai or Samsung. Some do not want to become like their fathers "who do nothing but work", says Chae Sang-heon, a professor at Yonam University in South Chuncheong province. Others take a dim view of their prospects, and say they "know they will never be a success like their father".

Comfort with digital technology gives young farmers a leg up, says Cho

Kyung-ik, the director of the Beginning Farmer's Centre, the government-affiliated institution which educates those who wish to kwichon at its offices near Gangnam, a posh area of Seoul. They sell fresh produce on Instagram and Naver, South Korea's largest search engine.

The centre also teaches techniques with which young Koreans tend to be less familiar—how to use a tractor or select the best crops. It arranges a trial period in the countryside during which aspiring farmers live and work under the tutelage of an old hand, learning what it means to do back-breaking labour from dawn to dusk. Mr Cho says the trial periods boost the chances of a successful transition.

The most important lesson on the syllabus is how to get on with the locals. Life is more communal in the countryside, and newcomers are expected to abandon their atomised urban ways; the neighbours' doorways, not just your own, should be swept when you get the broom out. The villagers are also offered tips on how to act towards the newcomers, especially the young ones, through role-playing sessions.

That part is not yet a total success. Ms Kim says her neighbours have a gruff streak. "The old people come in here and give me unwanted advice, or say that I will never be able to grow anything," she says. Her black soyabeans beg to differ. She and the South Korean government will be hoping that her corn and potatoes put the argument to rest for good. ■



大地之女

韩国年轻人返乡务农

政府给予鼓励，希望能振兴乡村

在首尔生活时，金智恩（Kim Ji-un，音译）担心找不到好工作和像样的住所。现在，她担心的是干旱可能会毁了她的土豆和玉米。今年23岁的金智恩和妹妹去年开始在忠清南道论山市经营一个农场。第一季的收成很好，她没想到黑豆比草莓的收成更好。

金智恩是所谓的“归村”大潮中的一员。这个一千年前创造的词总是会在经济困难时期出现，这时候城市居民被迫搬回家乡，通常是务农。这次是在疫情之后，许多像金智恩这样下乡务农的新农民以前从未在农村生活过。政府对大量韩国人涌向首都首尔的趋势感到忧虑，认为归农归村是振兴衰落的农村地区的一种途径，所以鼓励年轻人走向农村。政府希望，现在在农村培养年轻农民，未来会获得丰厚的回报。

这项计划正在奏效。2021年，近38万人搬到农村，比2015年增长了15%。其中近一半（创历史新高）不到40岁。和前几代人相比，这一代人没那么在意能否在韩国现代或三星等声名赫赫的财阀里找份工作。一些人不想变得像他们的父辈那样“一辈子只知道工作”，忠清南道莲庵大学（Yonam University）的教授蔡相宪（Chae Sang-heon）说。其他人则对自己的前景持悲观态度，说他们“知道自己永远不会像他们的父亲那样成功”。

熟悉数字技术给了年轻农民一定优势，新手农民中心（Beginning Farmer's Centre）的主任赵敬益（Cho Kyung-ik，音译）说，这个政府附属机构在首尔富人区江南附近的办公区为希望归村的人提供培训。年轻农民们在Instagram和韩国最大的搜索引擎Naver上销售新鲜农产品。

该中心还教授韩国年轻人如何驾驶拖拉机或挑选最好的农作物这些他们不太熟悉的活计。中心会在农村给年轻人安排一个试用期，让有志务农的人在老手们的指导下生活和工作，了解从早到晚从事繁重的体力劳动意味着

什么。赵敬益说，试用期能提高成功过渡的可能性。

培训内容中最重要的一课是如何与当地人相处。农村生活的集体色彩更浓，新来者需要放弃他们在城市里独来独往的生活方式，懂得不能各人自扫门前雪。村民们也会在角色扮演课程中学习如何对待新来者，尤其是年轻人。

这部分工作还没有完全成功。金智恩说她的邻居不怎么友好。“老人们会到我这儿给一些多余的建议，要么就说我永远种不出东西来。”她说。她收获的黑豆可不支持这种说法。她和韩国政府都会希望她的玉米和土豆收成能够平息争论。 ■



Bartleby

Is travelling to work always a waste of time?

In defence of commuting

AMERICANS ARE “always in a hurry”, wrote Alexis de Tocqueville in “Democracy in America”, his opus published in 1835. Until the covid-19 pandemic, nowhere was this more evident in recent decades than in packed trains at peak times as people commuted to work.

Almost 75% of professionals in America say the journey is what they dread most about going back to the office. Working remotely a few days a week is here to stay. Rush-hour traffic, overcrowded trains and transport strikes (like those on London’s tube last month) all argue for working from home. Across America and Europe rising fares eat into people’s salaries. The outcry for lower carbon emissions adds additional weight to the argument for millions of employees not undertaking unnecessary journeys. In some emerging cities, getting to work involves honks and epic gridlock as well as accidents.

Every now and again, most people will nevertheless need to make the trip to the office and back. Whether you are walking, cycling, on a Vespa, taking the bus, the tram or the subway, the range of options is wide, and rich in texture and colour. Some people will insist that no commute is ever worth the trouble. With the right attitude, though, it does not have to feel like temporary brain damage. This guest Bartleby, who takes the underground to The Economist’s London office three times a week, finds it both useful and oddly fulfilling.

Just how useful and fulfilling will depend on what exactly your commute looks like. But unless you hop into your car on your driveway and hop out at your company car park, it will involve at least some physical activity. If

you are cycling, or just picking up your walking pace to catch that bus or train, you combine being outdoors with an element of struggle—a healthy amount of which can be invigorating, not draining. And if you don't catch it, don't worry. Your hours have almost certainly become more flexible than the previous nine-to-five routine. That next train may anyway be less like a cattle car.

Like all dislocations, even regular and predictable ones, the daily commute is also a time and place where you are more exposed to physical and psychological elements from which you are shielded at home or at work. In “Falling in Love”, a film released in 1984, Meryl Streep and Robert De Niro meet as they commute on the same train month after month from the suburbs to New York City, until, one day, they embark on an emotional affair. The plot is banal and the dialogue dim but the idea that a journey injects a sense of risk and possibility is both deep and real.

Public transport, which a lot of commuting involves, remains the most democratic way of going to work. As chairman of the Federal Reserve from 1979 to 1987, Paul Volcker travelled coach class on the shuttle from New York to Washington, DC, and took the bus in both cities. As a public servant embodying civic duty, the central banker was known for his financial discipline in personal affairs, as well as monetary policy. At a time when greed was good, and limos, helicopters and private jets were great, frugality from “the custodian of the nation's money” sent a strong message. As companies bracing for a recession tighten their belts, Volcker's example seems particularly relevant.

Perhaps most important of all in an era of remote work, the commute helps mark out the mental distance between home and the office, which disappears when the kitchen table has become your work station. It offers a useful buffer—a liminal space separating the personal and the professional.

Getting ready to leave for work in the morning involves an element of planning—sometimes even anticipation. Stepping out of your home, and your comfort zone, you feel more alive by default. When walking to the train station, purpose is externalised and compressed. In the afternoon, you can use that time as a curtain to separate the day from the rest of the evening, probe into those pieces of inner life that nag and still feel connected to the world. Bartleby lets her thoughts meander while on the move. Time wasted is time gained.

Few people relish holing up in one place for ever. Working remotely from a secluded village in Italy may sound like a treat for a while. Yet like all sameness, it soon begins to feel stifling. In a modern world where de Tocqueville's words ring true of everyone everywhere, it may seem strange to add to the hurriedness. But not if you think of the commute as punctuation in the larger tale. ■



巴托比

为上班奔波就是在虚度时光吗？

为通勤正名

美国人“总是行色匆匆”，亚历克斯·德·托克维尔（Alexis de Tocqueville）在1835年出版的巨著《论美国的民主》（Democracy in America）中写道。在新冠疫情前的几十年里，最明显的例证莫过于上下班高峰期人满为患的列车车厢。

美国近75%的职场人士表示，通勤之路是他们害怕重返办公室的头号原因。每周有几天远程办公将成为常态。高峰期的交通、拥挤不堪的车厢以及交通行业罢工（正如上月的伦敦地铁工人罢工）都为居家办公提供了理由。在美国和欧洲，不断上涨的票价消耗了人们赚取的收入。碳减排的呼声愈发支撑了让成百上千万员工避免非必要出行的观点。在一些新兴城市，去上班要经历嘈杂路况、严重堵塞和交通事故。

尽管如此，大多数人仍需不时在家和办公室之间往返。无论是步行、骑自行车、踩踏板车、搭乘公交、有轨电车或是地铁，选择多种多样，多姿多彩。有些人会坚持认为通勤的种种麻烦根本不值得。但是，如果有好的心态，通勤也未必就会糟糕得让人心力交瘁。笔者每周三次乘地铁去《经济学人》的伦敦办公室，发现这样的旅程不仅有用，甚至出奇地充实。

究竟多有用、多充实，要看你通勤的具体情况。但是，除非你在自家楼下开车出发直达公司停车场，否则怎么都会有些体力活动。如果你骑自行车，或者只是快走几步追赶公交车或火车，你实际上已经在自己的户外时间里费了一点点劲——这点适量的运动可以让你精力充沛而不是精疲力竭。如果没赶上车，也别担心。跟以前的朝九晚五相比，现在的工作时间肯定已经变得更加灵活。而且下一趟火车也可能也不像运牛车那么拥挤不堪。

跟所有的奔波往返一样，即使是每日通勤这种按部就班、老套乏味的奔波

也能提供时间和空间，让人体验更多平日在家中或在工作中体验不到的身体和心灵感受。在1984年上映的电影《坠入情网》中，梅丽尔·斯特里普（Meryl Streep）和罗伯特·德尼罗（Robert De Niro）月复一月地在从郊区到纽约的同一列火车上相遇，直到有一天两人开始了一段感情纠葛。电影情节平庸，对白也没什么亮点，但它传达出的一段旅程可以带来冒险刺激感和可能性的看法却是深刻而切实的。

通勤普遍采用的公共交通仍然是最民主化的上班方式。保罗·沃尔克（Paul Volcker）在1979至1987年担任美联储主席期间，就曾乘坐经济舱往返纽约和华盛顿特区，并在这两个城市里搭乘公交车。作为一名集中体现公民义务的公务员，这位央行行长在个人事务上恪守的财务纪律性与其在货币政策上的坚持一样为人熟知。在那个追求贪婪，崇尚豪华轿车、直升机和私人飞机的年代，“国家货币监护人”的节俭作风发出了一个强烈的信号。在眼下企业为迎来经济衰退而紧缩开支之际，沃尔克似乎提供了尤其值得借鉴的范例。

也许最重要的是，在远程工作的时代，餐桌成了办公桌，家与办公室的距离消失，而通勤有助于划定家与办公室之间的心理距离。它提供了一个有用的缓冲——一个分隔个人生活和职业生活的阈限空间。

早上准备出门上班的过程中你会做一些计划安排——有时甚至还有些期待。走出家门，走出舒适区，你会自然而然地感到自己更有活力。步行前往火车站时，你的目标得以外化和浓缩在其上。下午，你可以把通勤时间视为幕帘，将日间的工作与晚上的时光分隔开来，探究一下内心世界中挥之不去的种种，但仍然感觉与现实世界相连接。在通勤途中，笔者任由自己的思绪自由驰骋。虚度的时光也是收获的时光。

极少有人会喜欢永远蛰居一处。在意大利的偏僻村庄里远程工作，一开始或许像是一种享受。然而，正如所有单调的事情一样，这很快就开始让人感到沉闷。在当今世界，托克维尔的描述适用于每个地方的每个人，还要为这种匆忙正名似乎有些奇怪。但若你把通勤看作是整个故事中的标点符号，也许会有另一番感受。■



Senescence

The genes of a jellyfish show how to live forever

The problem is that it requires a complete bodily metamorphosis

BILLIONAIRES SEEKING eternal life (and sponsorship of startup companies in this field suggests there are several of them around) could do worse than study *Turritopsis dohrnii*, known colloquially as “the immortal jellyfish”. It is not quite literally immortal. Individuals of the species do die. But those that live long enough can rejuvenate and, having done so, go through their whole lifecycles again. And again. And again.

As is true of most jellyfish, that lifecycle includes a sedentary, asexual stage, known as a polyp, and a swimming, sexual stage called a medusa. Larvae produced by sexual reproduction then develop into the polyps of the asexual stage. But *T. dohrnii* can generate polyps in another way, as well, by the reduction of a post-reproductive medusa to a cyst that then gives rise to one.

Pulling this trick off does, though, involve a lot of genetic jiggery pokery. And that is the subject of a study just published in the Proceedings of the National Academy of Sciences by Maria Pascual-Torner and Dido Carrero, of Oviedo University, in Spain, and their colleagues. By comparing the genome of *T. dohrnii* with that of a related, but mortal species, *T. rubra*, and also studying which genes are active during the process of rejuvenation, they have been able to identify some of the DNA that gives *T. dohrnii* its age-defying abilities.

Why animals become more decrepit with time, despite having repair mechanisms, is most easily explained by what is known as disposable-soma theory. This starts from the observation that regardless of how well it is maintained throughout the years, an individual organism is one day

going to be killed by a predator, a disease, a rival or an accident. Natural selection will therefore favour a successful youth over a successful old age, since the latter may never arrive. Repair is thus good enough, rather than perfect.

The result is that animals which do manage to get old suffer the consequences of their earlier exuberance. These include breakdown of DNA-repair mechanisms, oxidative damage caused as part of the chemical process of respiration, degradation of the structures, called telomeres, that cap a cell's chromosomes and loss of so-called pluripotent stem cells, which permit the repair of damaged tissues. Rejuvenating this lot is a big project.

To begin their investigation, Dr Pascual-Torner and Dr Carrero identified 1,000 genes from *T. dohrnii*'s genome that are known, in other species, to regulate aspects of ageing such as those listed above. Comparing these with the genome of *T. rubra* they identified 28 genes that had different numbers of copies in the two species, and thus, presumably, resulted in different amounts of the proteins they encoded, and also ten unique genetic variants.

These differences suggested that *T. dohrnii* did indeed invest heavily in DNA replication and repair, in regulating its response to oxidative stress, in repairing telomeres and in maintaining stem-cell pluripotency. Moreover, many of the genes involved were specifically activated during the transition from medusa to polyp.

There were also changes in genes with activities probably related to guiding that metamorphosis. These included genes regulating the transcription of DNA into RNA messenger molecules that carry instructions to a cell's protein factories, allowing a cell to be reprogrammed, and those governing the way cells communicate with each other, which would be important in

the wholesale bodily reshaping that the animal undergoes.

Some of this information may well illuminate understanding of the way human beings age. Though the common ancestor of jellyfish and vertebrates predates the Cambrian period, which began about 540m years ago, many of the genes involved are shared by the two groups, albeit with considerable differences.

That said, rejuvenation of the sort *T. dohrnii* experiences, which involves the body being largely rebuilt, does seem a rather extreme answer to the question, “would you like to live for ever?” ■



衰老

一种水母的基因揭示永生之秘诀

问题是这需要彻底“脱胎换骨”【新知】

寻求长生不老的亿万富翁们（看看这个领域里的创业公司背后的金主，就知道有好几位这样的人物）不妨去研究一下俗称“永生水母”的道恩灯塔水母（*Turritopsis dohrnii*）。这一物种并非真有不死之身。它的个体是会死亡的。但那些活得足够久的道恩灯塔水母能返老还童，然后重复整个生命周期。重复一次又一次。

和大多数水母一样，这个生命周期包括附着于海床的无性水螅体阶段以及浮游水中的有性水母体阶段。通过有性繁殖产下的幼虫会发育成无性的水螅体。但道恩灯塔水母还可以通过另一种方式生成水螅体——繁殖后的水母体还原为胚囊，继而长成水螅体。

不过，要完成这一魔法，少不了从基因上暗中使力。西班牙奥维耶多大学（Oviedo University）的玛利亚·帕斯夸尔-特纳尔（Maria Pascual-Torner）和迪多·卡雷罗（Dido Carrero）及其同事刚刚发表在《美国国家科学院院刊》（*Proceedings of the National Academy of Sciences*）上的一项研究正是以此为对象。他们比较了道恩灯塔水母和它不能“永生”的近亲深红灯塔水母（*T. rubra*）的基因组，并研究了有哪些基因活跃于再生过程中，得以识别出一些让道恩灯塔水母具备抗衰老功能的DNA。

动物尽管有修复机制，依然会日渐衰老，对此最简单的一种解释是“一次性体细胞理论”。这始于人们观察发现：一个生物体即使长年善加保养，还是可能死于捕食者、疾病、对手或事故之害。因此自然选择往往更偏爱成功的年轻阶段而非成功的老年阶段，毕竟后者也许永远也不会到来。所以，生物体的自我修复能力只是差不多够用而并不完美。

其结果是，能存活到老年的动物需要承受在年少时恣意挥洒生命力的后果，包括DNA修复机制崩溃、呼吸的化学反应造成氧化损伤、细胞染色体

末端名为“端粒”的结构退化、负责修复受损组织的多能干细胞流失。让这一切恢复到年轻时的状态可是项大工程。

在研究之初，帕斯夸尔-特纳尔和卡雷罗从道恩灯塔水母的基因组中找到了1000个基因——已知这些基因在其他物种身上参与调节了种种衰老因素，例如上述那些。他们把这些基因和深红灯塔水母的基因组相比较，发现这两个物种有28个基因具有不同的拷贝数，因而推测它们所编码的蛋白质数量也不同，而且还发现了10个独特的基因变体。

这些差异表明，道恩灯塔水母确实花了大力气复制和修复DNA，调节氧化应激的反应，修复端粒以及维护干细胞多能性。此外，这些基因有很多是在水母体蜕变为水螅体时才被激活的。

那些可能指导了这一蜕变的基因也发生了变化。其中包括调节DNA转录生成RNA信使分子的基因（这些信使分子向细胞的蛋白质工厂传递指令，从而重构细胞）以及控制细胞间沟通方式（在道恩灯塔水母的全面“变身”过程中非常重要）的基因。

这里面的一些信息很可能有助解开人类衰老的谜团。虽然水母和脊椎动物的共同祖先出现在约5.4亿年前的寒武纪之前，但许多与衰老相关的基因是这两个群体共有的，尽管差异不小。

但话说回来，对于“你想永生吗”这个问题，道恩灯塔水母那种基本重造了一具肉身的回春术似乎是个相当极端的答案。■



In the head, not on it

“Expected Goals” explains how data changed football

Data led to the rise of the “long-ball” game, then to its demise

Expected Goals. By Rory Smith. Mudlark; 304 pages; £20

THE MOST coveted figure in this summer’s European football-transfer window was neither a superstar player nor a feted coach. He was a data analyst. In just over a decade at Liverpool, Michael Edwards helped revitalise an underperforming giant of English football. When he left the club in May, a flurry of rivals tried unsuccessfully to sign him. His ascent is also the story of how football, long an anti-intellectual sport, finally realised that numbers could sharpen a competitive edge.

Mr Edwards was not the first to study English football through data. In the 1950s an accountant called Charles Reep began tallying passes, crosses and shots, annotating over 2,000 games and writing up his findings in the *Journal of the Royal Statistical Society*. His main conclusion was that a team’s chances of keeping the ball fell with each pass. The implication was that they should shoot on goal as quickly as possible. Reep is cited as an inspiration for the grim “long-ball” style of play that took off in England in the 1980s and peaked in Wimbledon’s victory in the FA Cup of 1988.

By the turn of the millennium, more in-game actions could be recorded more quickly and accurately. After his on-field career was curtailed by injury, Mr Edwards began a second one at Portsmouth in the early 2000s, combining data and video clips to analyse the opposition. In these early days, data was often used to berate players for their physical performance, such as how far they had run. But as Rory Smith of the *New York Times* explains in “Expected Goals”, a group of innovative firms and internet hobbyists gradually collated more and more match data and drew more

sophisticated conclusions. When Mr Edwards went to Liverpool, he built a data department that included an astrophysicist, a chess champion and a former researcher on the Higgs boson at CERN.

Analysts have faced plenty of resistance. Liverpool were mocked for giving them a say in player recruitment alongside Brendan Rodgers, then the manager. The club's American owners decided they preferred Mr Edwards's empirical approach and sacked Mr Rodgers. Under his successor, Jürgen Klopp, canny signings saw Liverpool overhaul rivals with much deeper pockets. "Liverpool's success gave English football a begrudging epiphany," writes Mr Smith. "It is the teams who do not invest [in data] who are considered outdated, old-fashioned, faintly neolithic."

Already, the adoption of analytics by most elite teams means the advantage conferred has shrunk. The launch of giant player databases has aided due diligence on potential signings. Tactics have changed too: long-range shots and crosses have declined in the Premier League as data has shown they might lead to fewer goals than many coaches realised.

Still, there is more to come. One club official tells Mr Smith that "there are no more than a handful of teams in English football doing anything even vaguely useful with analytics." In its secrecy, at least, football remains a closed shop. Nevertheless, "Expected Goals" is an upbeat tale of openness. Mr Edwards and others have proved there is more than one way to achieve success—and persuaded an often insular game to become more broad-minded. ■



动脑思考，不是起高球

《预期进球》讲解数据如何改变了足球

数据让“长传冲吊”先兴后衰【《预期进球》书评】

《预期进球》，罗里·史密斯著。穆德拉克出版社，304页，20英镑。

在今夏欧洲足球转会的窗口期，最炙手可热的人物不是哪个超级球星，也不是某位德高望重的教练，而是一名数据分析师。在十来年的时间里，迈克尔·爱德华兹（Michael Edwards）成功帮助英国足球的落魄豪门利物浦重振声威。今年5月他离开这家俱乐部时，竞争对手群起争抢，但都没有成功。他的声名鹊起也显示，向来反智的足球运动终于认识到数据能够提升竞争优势。

爱德华兹并非运用数据研究英国足球的第一人。上世纪50年代，一个名叫查尔斯·里普（Charles Reep）的会计师就开始统计传球、传中和射门数据，对2000多场比赛做了标注记录，并在《皇家统计学会杂志》（Journal of the Royal Statistical Society）上发表了自己的发现。他的主要结论是，球队保持控球权的几率随着每次传球而下降。这意味着球员应该尽快射门。里普的理论被认为是粗糙难看的“长传冲吊”打法的灵感来源，这种打法于上世纪80年代在英格兰兴起，在温布尔登队于1988年足总杯夺冠时达到巅峰。

到了世纪之交，球场上更多的动作可以被更快速准确地记录下来。在自己的球员生涯因伤病而提前结束后，爱德华兹在21世纪初在朴茨茅斯开启了第二职业生涯——结合数据和视频片段分析对手的状态。在这早期阶段，数据往往被拿来批评球员的体能水平，比如跑动距离。但正如《纽约时报》的罗里·史密斯（Rory Smith）在《预期进球》（Expected Goals）一书中解释的，一些创新的技术公司和球迷网友逐渐整理出越来越多的比赛数据，并得出更复杂深入的结论。爱德华兹在加盟利物浦俱乐部后新建了一个数据部门，成员包括一名天体物理学家、一名国际象棋冠军和一名曾在欧洲核子研究中心（CERN）研究希格斯玻色子的专家。

这些分析师曾面对相当大的阻力。利物浦俱乐部因在签约球员时让分析师与时任主教练布伦丹·罗杰斯（Brendan Rodgers）一同决策而遭到嘲讽。俱乐部的美国老板最终选择了爱德华兹的经验主义方法，解雇了罗杰斯。在继任者尤尔根·克洛普（Jürgen Klopp）的带领下，利物浦精明地签下优秀球员，球队成绩赶超了财力更雄厚的对手。“利物浦的成功让英国足球界心不甘情不愿地醒悟了，”史密斯写道，“如今那些不投资[数据]的球队会被认为是过时守旧的老古董。”

目前大多数顶级球队都启用了数据分析，由此而来的优势已经缩小。庞大的球员数据库的问世辅助了对潜在签约球员的尽职调查。战术也发生了变化：在英超联赛中，远射和传中减少了，因为数据显示它们带来的进球数可能比许多教练以为的要少。

不过在这方面还有发展空间。一位足球俱乐部官员告诉史密斯，“只有少数几支英国足球队在运用数据分析做一些哪怕只是略有建设性的事情”。至少从行事隐秘上来说，足球界依旧是个封闭的圈子。然而，《预期进球》讲述的是一个关于开放的积极乐观的故事。爱德华兹等人证明了获胜之路不止一条，并成功说服了一项通常封闭保守的运动变得更胸襟开阔。





Electric vehicles

Swappable batteries for electric vans and lorries make sense

Car drivers, though, will probably want to keep recharging

ONE OF THE most successful battery-swapping schemes for electric vehicles (EVs) is run by Gogoro, a Taiwanese firm. It has some 500,000 subscribers who, in return for a monthly fee, can quickly exchange depleted batteries from their electric mopeds and scooters for fully charged ones at a network of kiosks around the country. What makes Gogoro's scheme so popular is that it uses a standardised battery which fits into machines produced by different manufacturers.

Japan's giant automakers are now looking at doing something similar with delivery vans and light trucks. A consortium of Daihatsu, Isuzu, Hino, Suzuki and Toyota is exploring the use of easily detached "cartridge" batteries to power such vehicles. These cartridges would be smaller than the fixed batteries of typical EVs (though several could be bundled to provide more range) and would be standardised to fit any vehicle adapted to the system. When empty, they could be removed and replaced quickly with fully charged ones at automated drive-in swap stations. Yamato Transport, a big Japanese delivery service, is working with the consortium on ways to set up a network of such stations.

Swapping batteries like this would be a useful way of powering commercial EVs that are constantly on the road and therefore require frequent recharging. Conventional fast charging, of the sort a private motorist might employ at a service station, is intended only for occasional use because doing it repeatedly strains a battery, shortening its working life. Swapped-out battery cassettes, by contrast, can be recharged slowly and efficiently, but without keeping a vehicle off the road. The consortium thinks battery swapping might help cut peak electricity demand at businesses as well, by

eliminating end-of-shift surges when lots of vehicles return to base and plug in simultaneously.

The consortium will also have to decide whether to sell cartridge batteries outright and let transport companies do their own swapping, or lease them and rely on third-party swap-stations. If they do come up with a workable scheme, it might encourage producers of commercial EVs in other countries to try something similar. But there are a lot of bumps in the road ahead before any of this will happen.

For one thing, it is not just a common specification for the battery that has to be agreed, but also the means by which it is attached and removed. That impinges on how companies design their vehicles, making agreement harder to come by. At present there is little standardisation in the EV business. Batteries come in many shapes and sizes, and chargers work with some vehicles but not others. A lot of batteries are also tricky to remove. Increasingly, indeed, they are designed into vehicles as part of the structure. Manufacturers who once assumed batteries would become commoditised now develop their own, employing them to provide commercial advantages such as increased range, faster acceleration and quicker charging.

The success of a battery-swapping scheme would thus depend on how its cost compared with charging batteries in situ—though both options would probably be available on any given commercial vehicle. For private cars, where leasing batteries has not been popular, success is less likely.

Battery-swapping schemes for cars do exist. Nio, a Chinese carmaker, provides swap stations in its home market, where many people live in apartments and so have no access to home charging. But most manufacturers are looking at better batteries and improved charging infrastructure.

Tesla, America's biggest EV producer, considered battery swapping but ditched the idea in favour of developing its own Supercharger network. And charging times on most networks are coming down, with some high-voltage systems able to top up batteries from 20% to 80% in under 20 minutes. That still does not overcome the battery-strain problem. But future batteries, particularly the solid-state variety that some companies are developing, promise to be smaller and capable of greater range, so will need charging less often. Most private electric-car drivers will thus still need to keep their charging cables handy. ■



电动车

电动货车和卡车使用可更换电池是合理方案

不过私家车主们可能会想要继续给车充电

最成功的电动车电池更换项目之一是由台湾公司Gogoro运营的。该公司拥有约50万订户，他们缴纳一笔月费，即可前往遍布岛内各地的任一服务站，把自己电动摩托车上电量耗尽的电池迅速更换成充满电的电池。

Gogoro的项目之所以如此受欢迎，是因为它使用了标准化电池，可以适配不同制造商生产的电动机车。

日本多家汽车制造巨头正考虑在厢式货车和轻型卡车上做类似的尝试。大发、五十铃、日野、铃木和丰田组成了一个财团，正在开发易于拆卸的“盒式”电池作为这些送货车辆的动力源。这些盒式电池会比一般电动车的固定式电池要小（但可以捆绑安装多个以提供更长续航），而且标准化的设计让它们可被安装到任何与该系统适配的车辆上。电量用尽时，车主可以在免下车的自动化换电站把电池盒拆卸下来，快速更换为充满电的电池。日本大型快递公司雅玛多集团正与该财团合作，研究如何建立这样的换电站网络。

对于总在路上行驶而需要频繁充电的商用电动车而言，如此更换电池是个有用的动力方案。传统的快速充电，比如私家车可能在服务站使用的那种，只适合偶尔使用，因为反复快充会损伤电池，缩短其工作寿命。相比之下，换下来的盒式电池可以慢速高效充电，而车子还能立刻继续上路。该财团认为，更换电池还可能有助减低企业的高峰用电需求，因为这样可以消除班次结束后大量电动车辆返回基地同时充电造成的用电激增。

该财团还必须决定是直接出售盒式电池让运输企业自己更换，还是出租电池并依赖第三方换电站提供服务。假如他们能拿出可行计划，也许会鼓励其他国家的商用电动车生产商采取类似的行动。但无论选择哪种计划，前方的路途都不会平坦。

首先，需要达成一致的不仅是电池规格，还有电池的安装和拆卸方式。这会影响到汽车公司的车辆设计方案，让共识更难达成。目前，电动车行业的标准化程度不高。电池的形状尺寸五花八门，充电器也不是完全通用的。许多电池拆卸起来也很麻烦。事实上，电池越来越多地被设计为汽车的结构性组件。曾认为电池会商品化的制造商现在都在自己研发电池以求获得商业优势，比如续航更长、加速更快和充电更迅速。

因此，可更换电池项目的成败将取决于它与直接充电的成本比较，当然所有商用电动车可能都会保留这两种选择。而在私家车方面，租赁电池一直都不流行，所以它成功的可能性更小。

汽车换电池的方案确实已有实施。中国汽车制造商蔚来在国内市场提供换电站，因为很多中国人住在公寓楼里，无法在家给车充电。但大多数制造商都在研究改进电池和充电基础设施。

美国最大的电动车生产商特斯拉曾考虑过采用可更换电池，但最终放弃，转而发展自有的超级充电网络。而且大多数网络的充电时间都在缩短，一些高压系统能在20分钟内把电量从20%充至80%。快充伤电池的问题仍未能克服。但未来的电池，尤其是一些公司正在开发的固态电池，有望做到体积更小、续航更久，所以无需频繁充电。所以，大多数私家电动车车主还是要随车携带充电线缆。 ■



Schumpeter

Could the demonised oil industry become a force for decarbonisation?

That may be what Warren Buffett sees in Occidental Petroleum?

WHEN WARREN BUFFETT was asked to explain in April why Berkshire Hathaway, his investment firm, had built a 14% stake in Occidental Petroleum, or Oxy, over a frenetic fortnight of buying starting two months earlier, his answer was long. It included a digression into John Maynard Keynes's "General Theory" of 1936, and a rollicking description of why Wall Street still resembles a gambling parlour, as it did back then. He barely mentioned the Houston-based oil company, now worth \$69bn, besides saying that he had read Oxy's annual report for 2021 and that Vicki Hollub, its boss, "made nothing but sense". The pithiest explanation came from Charlie Munger, Mr Buffett's long-standing sidekick: "We found some things we preferred owning to treasury bills."

It hardly sounded like a resounding endorsement. Yet Berkshire's stake has since climbed above 20%, making it Oxy's biggest shareholder by far, and on August 19th it got authorisation from an energy regulator to purchase up to half of the firm's shares. The buying spree has made Oxy the highest climber this year in the S&P 500, one of America's stockmarket benchmarks. It has also fuelled speculation that it is the prelude to a takeover.

Whether it has grander designs or not, it will come as no surprise that a firm like Berkshire, whose energy subsidiary includes coal-fired power plants and whose freight trains run on diesel, is keen to invest in oil. Though it also has huge wind and solar capacity, its nonagenarian executives are proudly old school. As for their faith in Ms Hollub, a cynic might say her greatest appeal is the value destruction she unleashed when Oxy bought Anadarko, a rival, for \$55bn in 2019. The aftermath of that ill-

timed deal, shortly before the pandemic, caused the debt-ridden firm to underperform its American peers—at least until oil markets rebounded this year. Mr Buffett likes nothing better than a cheap old-economy stock, especially one belching cash.

That's one way of looking at it. Another is that Mr Buffett, who supported Ms Hollub's bid for Anadarko by providing \$10bn of high-yielding investment, has come to appreciate her idiosyncratic approach to America's oil business. For what it's worth, Schumpeter, who first met Ms Hollub six years ago, has long considered her a cut above the average American oil-industry boss. An engineer by training, back then she went into detail explaining how Oxy increased the yield of old oil wells by pumping in carbon dioxide to dislodge the residual crude, which she said lowered the costs, as well as the carbon footprint, of each barrel. Today, she doubles down on that, saying that Oxy is on the verge of building a carbon-management business that could reach the size of its oil-and-gas one by 2050—which she says could make it the “last company standing” in America's oil industry. As she puts it: “Oxy is what an oil and gas company of the future has to look like.”

What she means is that, in addition to pumping more oil and gas, Oxy is betting on carbon-sequestration technologies to lower its net carbon footprint. The main one is direct air capture (DAC), a way of sucking CO₂ from the atmosphere through giant extraction fans and burying it underground. Oxy will soon start construction of its first DAC plant, which will cost up to \$1bn and be located in the Permian Basin of Texas. Its baseline plans are to build 70 worldwide by 2035. They are critical to the firm's pledge to become fully net-zero by mid-century. But Ms Hollub also hopes they will become a big business in their own right as companies pay for carbon sequestration to offset their emissions. United Airlines and Airbus, an aircraft manufacturer, are early backers.

A tailwind is whipping up. America's newly approved Inflation Reduction Act substantially increases DAC tax credits (though per tonne of CO₂ sequestered it remains eye-wateringly expensive). If costs come down, the recent stampede by companies to commit to net-zero targets is likely to create "incredible demand" for carbon sequestration, including DAC, says Michael Greenstone, a professor of economics at the University of Chicago. "Everyone wants a guaranteed way of removing tonnes of CO₂."

There's a sting in the tail. Oxy will continue to use plenty of the sequestered gas for enhanced oil recovery, its decades-old practice of using CO₂ to squeeze more oil out of reservoirs. When that fuel is burned, it will add to the stock of carbon in the atmosphere, reducing some of the benefits of storage. Moreover, Oxy's low-carbon wager is, as yet, still relatively small. This year it intends to spend \$100m-300m on low-carbon ventures, compared with total capex of up to \$4.3bn. Given the scale of the climate problem, it goes without saying that many will dismiss small decarbonisation steps by the oil industry as greenwashing. Thom Allen of Carbon Tracker, an NGO, estimates that the energy industry worldwide emits nearly 1,000-times more tonnes of greenhouse gases a year than there is capacity for all forms of carbon capture and storage.

| *Sewage system for the planet*

Those are justifiable red flags. Yet they miss a big point. While people still want to use oil and gas to run factories, homes and vehicles, the fossil fuels need to come from somewhere and the less net carbon they add to the atmosphere, the better. Ms Hollub is not blinkered by the industry's survival instincts. She laments some efforts to halt climate legislation by the industry's lobbyists. Her bet on sequestration is also supported by science: ultimately, some forms of carbon removal are as vital for cleaning the air as sewage systems are for handling household waste.

Whether such arguments appeal to Mr Buffett she is loth to say—though

she points out that Kraft Heinz, a consumer-goods company part-owned by Berkshire, recently struck a big renewables deal with one of its energy subsidiaries. The Sage of Omaha may be old school, but he surely notices how the tide is turning in favour of renewables. No doubt he likes Oxy's oil. But the unfashionable idea that the demonised petroleum industry can help spearhead decarbonisation probably tickles him, too. ■



熊彼特

被妖魔化的石油行业能否成为脱碳生力军？

巴菲特也许觉得Oxy公司有这个潜质？

今年4月，有人请沃伦·巴菲特解释一下，为什么两个月前他的投资公司伯克希尔·哈撒韦公司在两周里疯狂购入了西方石油公司（Occidental Petroleum，简称Oxy）14%的股份？他给出了一个很长的回答。他跑题聊起了1936年出版的凯恩斯的《通论》（General Theory），嬉笑着讲述为什么今天的华尔街还和那个年代里一样像个赌馆。他几乎没有提到这家总部位于休斯顿、目前市值690亿美元的石油公司，只说他已经读过Oxy的2021年年报，又说该公司老板维基·霍卢布（Vicki Hollub）“没别的，就是靠谱”。还是他的长期搭档查理·芒格给出的解释最言简意赅：“我们发现了一些相比美国国债我们更愿意持有的东西。”

这听起来不像是一个响亮的支持。然而自那之后，伯克希尔持有的股份已经突破20%，成为Oxy毫无疑问的最大股东。8月19日，它得到了一家能源监管机构的批准，最多可以购买该公司一半的股份。这波疯狂买入使得Oxy成为美股基准之一标普500今年涨幅最高的公司，也引发外界猜测这是收购的前奏。

不管伯克希尔是不是在下一盘更大的棋，像它这样的公司热衷投资石油也不让人意外。伯克希尔的能源子公司中有煤电厂，它的货运列车也使用柴油。虽然它也有巨大的风能和太阳能装机容量，但它年过九旬的高管还是很老派，并以此为傲。至于他们对霍卢布的信心，对此不以为然的人可能会说，她最大的吸引力就是她在2019年Oxy以550亿美元收购竞争对手阿纳达科（Anadarko）时造成的价值损失。这笔交易做得很不是时候——不久后就发生了疫情——导致这家债务缠身的公司表现逊于美国同行，至少在今年石油市场反弹之前是如此。巴菲特最喜欢便宜的传统经济股票，尤其是一只日进斗金的股票。

这是看待它的一种角度。另一种是，巴菲特（提供了100亿美元高收益投

资支持霍卢布竞购阿纳达科)开始欣赏她对美国石油业务别具一格的处理方式。不管怎么说,笔者一直都认为霍卢布比一般的美国石油业老板更胜一筹。六年前第一次见到她时,工程师出身的她详细解释了Oxy如何通过泵入二氧化碳去除原油残渣来提高旧油井的产量,她说这降低了成本以及每桶油的碳足迹。今天,她在这方面加倍努力,称Oxy即将组建一个碳管理业务,到2050年可能匹敌该公司油气业务的规模——她说这可能使Oxy成为美国石油行业“最后一家屹立不倒的公司”。用她的话说,“Oxy就是未来的石油和天然气公司该有的样子。”

她的意思是,除了开采更多的石油和天然气,Oxy还押注于碳封存技术,以降低自身净碳足迹。其中一大技术是直接空气捕获(DAC),通过巨大的抽风机从大气中吸收二氧化碳并将之埋于地下。Oxy很快就会开始建设它的首座DAC工厂,造价将高达10亿美元,选址得克萨斯州的二叠纪盆地。公司的基线计划是到2035年在全球建造70座DAC工厂。这些工厂对于该公司在本世纪中叶完全实现净零排放的承诺至关重要。但霍卢布也希望,随着各类企业为碳封存付费以抵消自身碳排放,这些工厂本身也会带来一笔大生意。联合航空公司(United Airlines)和飞机制造商空客是早期的支持者。

一股顺风正越吹越强。美国新批准的《降低通胀法案》(Inflation Reduction Act)大幅提高了DAC税收抵免(尽管封存一吨二氧化碳仍然贵得惊人)。如果成本能下来,近来企业竞相承诺净零目标的热潮很可能会创造对包括DAC在内的碳封存“难以置信的高需求”,芝加哥大学经济学教授迈克尔·格林斯通(Michael Greenstone)说,“人人都希望有一种万全的方法来去除大量二氧化碳。”

然而事情还有反转。Oxy将继续大量使用封存的碳来提高石油采收率——像过去几十年来那样,利用二氧化碳从油藏中榨出更多石油。当这些石油燃烧时又会增加大气中的碳含量,令碳储存的好处打折扣。此外,Oxy押注低碳的手笔仍然相对较小。今年,该公司打算在低碳项目上投资1亿至3亿美元,而总资本支出高达43亿美元。以气候问题的严峻程度,不消说,石油行业小打小闹的脱碳措施会被很多人认为是“漂绿”行为。非政府组织

碳追踪（Carbon Tracker）的汤姆·艾伦（Thom Allen）估计，全球能源行业温室气体的年排放量是所有形式的碳捕获和储存产能的近1000倍。

| 地球的排污系统

指出这些问题是有道理的。但它们忽略了重要的一点。在人们仍然想用石油和天然气来运转工厂、家庭和车辆之时，化石燃料总得来自某处，而它们在大气中的净排放量越少越好。霍卢布没有被这个行业的生存本能所蒙蔽，她对本行业游说者阻挠气候立法的一些行动表示遗憾。她对碳封存的押注也有科学依据：最终，某些脱碳方式对于净化空气的重要性不亚于污水系统对于处理家庭垃圾的重要性。

她拒绝透露这些论点是否吸引了巴菲特。不过她指出伯克希尔部分持股的消费品公司卡夫亨氏最近与其能源子公司之一达成了一笔可再生能源的大买卖。这位奥马哈的圣人也许老派，但他肯定注意到潮流正在转向，利好可再生能源。毫无疑问，他喜欢Oxy的石油。但是，被妖魔化的石油工业可以帮助引领脱碳行动这样并不时兴的观点可能也让他挺高兴。■



Commodities

Against expectations, global food prices have tumbled

Why the war in Ukraine has caused less disruption than feared

SIX MONTHS after Russian tanks rolled into Ukraine, an inflationary shock is still ripping through boardrooms, finance ministries and households. But in one crucial area, prices have come back to Earth. The cost of grains, cereals and oils, staples of diets around the world, has returned to levels last seen before the war began.

Russia and Ukraine are agricultural powerhouses—until recently, the world's largest and fifth-largest exporters of wheat and two largest exporters of sunflower oil. It was not, therefore, a surprise that food prices surged in February and March, driven by fears that exports would be disrupted by war; indeed, the worry was that shortages would persist, decimating grain stocks and causing mass starvation.

That terrible outcome now appears to have been avoided. In mid-August wheat futures in Chicago, for delivery in December, dropped to \$7.70 per bushel, far below the \$12.79 they reached three months earlier and back to their level in February. Corn is also back to its pre-war price. Meanwhile, palm oil, found in thousands of dishes from ice cream to instant noodles, has dropped back not only to its pre-war price, but below it (see chart).

The recent deal brokered by the United Nations, allowing Ukrainian grain exports to leave the port of Odessa, can only explain a fraction of the shift: it was signed in late July, after most of the decline in prices. More can be credited to the strength of Russian wheat exports. America's agriculture department suggests that Russian farms, far from being disrupted, will export a record 38m tonnes in 2022-23, some 2m tonnes more than they

managed the previous year. A bumper harvest is underway, in part due to good weather earlier in the year, and there is strong demand from traditional importers in north Africa, the Middle East and Asia.

The worries about shortages may have been overstated in the first place. Charles Robertson of Renaissance Capital, an investment bank, argued at the time that cereal traders were overexcited—wrongly grouping together long-term disruption to oil-and-gas supplies and less plausible prolonged disruption to the food supply. “Global wheat stocks were extremely high,” says Mr Robertson, “which told us either that the relationship between stocks and prices had broken down or...that speculation had got ahead of itself.”

The sheer volume of speculation on futures markets may also help explain the volatility. Michael Greenberger of the University of Maryland, formerly a division director at the Commodity Futures Trading Commission, a regulator, notes that rules limiting speculation are routinely avoided by American banks, which assign swaps to their foreign subsidiaries.

The drop in prices will not immediately feed through to consumers. Wheat and other cereal prices have returned to their pre-invasion levels when priced in dollars, but not in many other currencies. The greenback has climbed this year on the expectation of more rapid interest-rate rises by the Federal Reserve, leaving some emerging-market economies struggling. The Turkish lira is down by 27% against the dollar this year and the Egyptian pound is down 18%. The countries are two of the three largest wheat importers in the world.

Prices were high by historical standards even before the war, and there is no guarantee they will not rise again. Droughts across much of the world will affect crop yields. Meanwhile, fertilisers are still expensive. Urea, a compound used in the production of nitrogen-based ones, currently runs

to \$680 per tonne—down from \$955 in mid-April, but still a lot more than the \$400 it cost a year ago. That reflects the surging cost of natural gas, an ingredient in fertilisers. With fuel prices in Europe continuing to hit record highs, there may be more nasty surprises in store. ■



大宗商品

出人意料，全球粮食价格大跌

为什么乌克兰战争造成的干扰比人们担心的要小

俄罗斯坦克开进乌克兰六个月后，通胀高企仍在冲击公司董事会、各国财政部和千家万户。但在一个关键领域，价格已经回落。谷物和油等全球性主粮的价格已经恢复到战争前的水平。

俄罗斯和乌克兰是农业大国——直到最近，它们还是世界上第一大和第五大小麦出口国，以及两个最大的葵花籽油出口国。因此，2月至3月食品价格飙升不足为奇，因为人们担心战争会中断出口；实际上，人们担心的是粮食短缺会持续下去，耗尽粮食库存，引发大规模饥荒。

现在看来，这种可怕的结果似乎不会发生了。8月中旬，芝加哥12月交割的小麦期货价格跌至每蒲式耳7.70美元，远低于3个月前的12.79美元，回到了2月份的水平。玉米也回到了战前价格。与此同时，从冰淇淋到方便面等成千上万种食物里都含有的棕榈油的价格在回落到战前水平后还继续下探（见图表）

最近由联合国斡旋达成的协议允许乌克兰通过敖德萨港出口粮食，但这只是这一转变的一小部分原因：该协议是在7月下旬签署的，当时粮价已经大幅下跌。更大的原因是俄罗斯小麦的强劲出口。美国农业部表示，俄罗斯农场非但没有受到干扰，还会在2022年至2023年创下3800万吨的出口纪录，比前一年多出约200万吨。丰收年已然在望，原因之一是今年早些时候气候甚佳，而且北非、中东和亚洲的传统进口地需求旺盛。

对短缺的担忧可能一开始就被夸大了。投资银行复兴资本（Renaissance Capital）的查尔斯·罗伯逊（Charles Robertson）当时就认为，谷类贸易商过于兴奋，错误地将石油和天然气供应的长期中断与不太可能的粮食供应长时间中断捆绑在一起。“全球小麦库存极高，”罗伯逊表示，“这告诉我们，要么是库存与价格之间的关联断裂了，要么就是.....投机过头了。”

期货市场的大量投机也可能有助于解释这一波动。马里兰大学的迈克尔·格林伯格（Michael Greenberger）曾担任监管机构商品期货交易委员会（Commodity Futures Trading Commission）的部门主管，他指出，美国的银行经常性地绕开限制投机的规则，把掉期合约交给它们的境外子公司交易。

价格下跌不会立刻传递给消费者。小麦和其他谷物的美元价格已经恢复到俄罗斯入侵乌克兰之前的水平，但按许多其他货币计价还没有。由于预计美联储会更快加息，美元今年已经走高，令一些新兴市场经济体陷入困境。土耳其里拉兑美元汇率今年下跌了27%，埃及镑兑美元下跌了18%。这两个国家在世界前三大小麦进口国中占两席。

以历史标准衡量粮价在战争爆发前就已经处于高位，而且不能保证不会再次上涨。席卷世界多地的干旱将影响农作物产量。与此同时，化肥仍然很贵。尿素这种用于生产氨基复合肥的化合物目前的价格为每吨680美元，低于4月中旬的每吨955美元，但仍远高于一年前的每吨400美元。这反映了化肥的原料之一天然气的价格飙升。随着欧洲的燃料价格不断创下历史新高，可能还会有更多令人不悦的意外发生。■



Mates' rates

The connection between Russian sanctions and bizarre Turkish monetary policy

Russian cash has uses beyond the obvious

MANY COUNTRIES are moving away from Russia, but one is getting closer: Turkey. Russian tourists and émigrés are pouring into Istanbul and the country's coastal resorts, snapping up properties by the thousand. Russia is helping to fund a nuclear plant costing \$2obn in Akkuyu, in the south. While many countries have cut exports to Russia since its invasion of Ukraine, Turkey's have surged by 60% in dollar terms. Western firms, constrained by sanctions, appear to be using Turkey as a go-between to export to Russia.

Turkey's bizarre monetary policy is one reason why the country is so keen on Russian cash. Despite inflation soaring to 80%, on August 18th Turkey's central bank cut its interest rate from 14% to 13%—the opposite response to what any sane economist would recommend. Recep Tayyip Erdogan, Turkey's president, wants lower borrowing costs in order to goose the economy, and thus improve his chances at the election next summer. But loose monetary policy has caused the lira to slide. It has lost three-quarters of its value against the dollar since 2018, and a weaker currency adds to Turkey's inflation difficulties by raising the cost of imports still higher.

Enter the sanctions-busting gambit. Turkey desperately needs foreign currencies in order to buy lira on financial markets, thus supporting the currency's value without raising rates. The central bank has probably spent tens of billions of dollars in this way in recent months. Russia is swimming in hard currency from exports of hydrocarbons, and is short on friends and foreign goods. Turkish exports to Russia help bolster Mr Erdogan's foreign reserves, since exporters now have to exchange some of their foreign

earnings with the government for domestic currency. Sanctions-busting and madcap monetary policy are thus two sides of the same coin.

American politicians have signalled their unease at Turkey's strategy. Analysts warn it risks secondary sanctions. But Mr Erdogan sees money as more important than warm relations with the West. "He has an election to win," says Timothy Ash of BlueBay Asset Management. "He is going to push it to the limit". ■



友情价

俄罗斯受制裁与土耳其怪异货币政策之间的关联

俄罗斯资金暗里的用途

许多国家正在远离俄罗斯，但有一个国家却跟俄罗斯越走越近——土耳其。俄罗斯游客和移民涌入伊斯坦布尔和该国的沿海度假胜地，抢购成千上万的房产。俄罗斯正在帮助土耳其南部的阿库尤（Akkuyu）一座耗资200亿美元的核电站融资。自俄罗斯入侵乌克兰以来，许多国家都削减了对俄出口，但土耳其对俄出口以美元计却飙升了60%。在制裁的限制之下，西方公司似乎正用土耳其充当对俄出口的中间人。

土耳其采取的匪夷所思的货币政策是该国积极追逐俄罗斯资金的原因之一。尽管通胀率已经飙升至80%，土耳其央行却在8月18日将利率从14%下调至13%——与任何理智的经济学家会给出的建议背道而驰。土耳其总统埃尔多安希望降低借贷成本以刺激经济，提高自己在明年夏天大选中的胜算。但是宽松的货币政策导致里拉贬值。自2018年以来，里拉兑美元汇率已经跌去了四分之三，而货币贬值又进一步推高进口成本，使土耳其的通胀问题愈发严重。

于是就有了打破制裁的路数。土耳其亟需外汇，以便在金融市场上买入里拉，从而能在不加息的情况下支撑汇率。近几个月来，土耳其央行可能已经为此耗费了数百亿美元。俄罗斯通过油气出口赚取了大量硬通货，但缺乏朋友和外国商品。对俄出口可以帮助埃尔多安增加外汇储备，因为土耳其出口商现在须用部分外汇所得向政府兑换本币。这样一来，打破制裁和鲁莽的货币政策就相通了。

美国政界人士已经暗示土耳其的策略令他们不安。分析人士警告称，这可能招致二级制裁。但埃尔多安认为金钱比与西方的友好关系更重要。“他需要赢得选举，”BlueBay资产管理公司的蒂莫西·阿什（Timothy Ash）表示，“他会把这招用到极限”。■



Modification revolution

Science has made a new genetic revolution possible

Now let it flourish

THANKS TO GREAT strides in fundamental research, biology is becoming ever more programmable. Two recent scientific advances show just how powerful the possibilities could be. The genetic modification of plants is allowing the mechanism of photosynthesis to be tinkered with, as research published in Science on August 18th sets out. This could lead to dramatic improvements in the productivity of plants, and eventually to a second green revolution. Tweaking the genes of people who suffer from fatal incurable diseases, meanwhile, has also had remarkable results. A series of genetic therapies has arrived, or is arriving, in clinics to treat blood cancers, spinal muscular atrophy, haemophilia and sickle-cell disease. The task now is to spread these gains far and wide.

The consequences of both advances could be momentous. The genetic modification of crops promises cheaper, more nutritious and more climate-resilient food for a hungry planet. Genetic therapies offer the hope of curing devastating diseases. They also allow for one-time treatments that can be transported to the four corners of the Earth, bringing years, decades or a lifetime of benefits to the seriously and incurably ill. Imagine a cure for AIDS or sickle-cell disease that could be taken to the continent of Africa or across the Middle East. The accompanying benefits would be similar to the eradication of smallpox.

This tantalising promise has been made possible by a prodigious investment in fundamental research over the years. Basic knowledge of genetics and the functions and structures of proteins has proved to be a motor for discovery across medicine and agriculture. The private sector, to be sure, plays an essential role in the cycle of innovation. But these

advances are a reminder that investment by governments and charities is crucial in areas that offer little commercial benefit in the short term, but which in the long term promise to greatly advance well-being. Much of the success in treating rare diseases is a consequence of the efforts of charities, often thanks to fundraising by patients and their families. Research that benefits low-income countries frequently relies on philanthropic donors with deep pockets, such as the Gates Foundation. The investments made in fundamental science today yield the productivity gains of tomorrow.

Unfortunately, there is no guarantee that these gains will be realised. Gene therapies are a remarkable technical accomplishment. But their current enormous cost—often well over \$1m to treat a single person—makes them hard for health-care systems to afford, even when they are reserved for fatal rare genetic diseases. The idea of using them to treat more prevalent conditions looks prohibitively pricey.

In the past, novel medicines that started out extremely costly have become cheaper. Monoclonal antibodies, useful laboratory-made proteins, were expensive when they first arrived, before a decade of advances brought them down in price 50-fold, according to Boston Consulting Group. If gene therapy is to live up to its promise, it will need to do even better than this. More efficient photosynthesis, too, will need further investment if it is to be commercialised.

The long-term manufacturing costs of a new green revolution will, thankfully, be low; plants make more plants in a way that treatments never can. Gene therapies, however, need innovation to reduce the cost of making them, whether this is in bioreactors or some completely novel way. If they are to become more affordable, new therapies also need to experiment with payment mechanisms, such as charging in instalments or by results. Pooling demand internationally to purchase therapies could help lower prices, too. Here governments, charities and the private sector could

usefully work together.

Last, regulators also need to be quicker and more understanding of the gains to society from helping these technologies reach their potential. Innovations can languish without appropriate or timely rule-making. The regulation of genetically modified crops has been held back by misinformation campaigns, delaying benefits and raising costs. Likewise, although experimental drugs obviously need scrutiny, regulators should remember that the alternative in otherwise untreatable genetic diseases is often death. Science has made a genetic revolution possible. Now that revolution must flourish. ■



【首文】改造革命

科学已让新的基因革命成为可能

现在就让它蓬勃发展吧

基础研究取得的长足进步使得生物学日趋“可编程”。最近的两项科学进步显示了其潜力可能有多强大。8月18日发表在《科学》杂志上的研究表明，通过基因改造可以调整植物的光合作用机制。这可能会显著提高植物的生产力，并最终引发第二次绿色革命。与此同时，针对绝症病人的基因改造也取得了显著成果。一系列用于治疗血癌、脊髓性肌萎缩、血友病和镰状细胞病的基因疗法已经或即将进入临床。眼下的任务是将这些成果推广开来。

这两项进步可能意义重大。农作物的基因改造有望为饥饿的地球提供更便宜、更有营养、更能适应气候变化的食物。基因疗法为治愈毁灭性疾病提供了希望，还能把一次性治疗带到世界各个角落，为重症和绝症病人带来数年、数十年乃至终生的益处。想象一下，如果治愈艾滋病或镰状细胞病的疗法可以推广到非洲大陆或整个中东，随之而来的好处将类似于根除天花。

这一吸引人的前景植根于多年来对基础研究的巨大投资。遗传学和有关蛋白质的功能及结构的基础知识推动了医学和农业领域里的发现。私营部门在这一创新周期中无疑发挥着不可或缺的作用。但这些进步提醒人们，在一些短期内没有什么商业利益、但长远有望极大促进人类福祉的领域，政府和慈善机构的投资至关重要。治疗罕见疾病的成功大部分都是慈善机构努力的结果，通常要归功于患者及其家人的筹款。让低收入国家受益的研究经常依赖财力雄厚的慈善捐助机构，比如盖茨基金会。今天对基础科学的投资带来明天生产率的提升。

可惜，并不能保证这样的提升一定能够兑现。基因疗法是一项了不起的技术成就，但目前费用极高，治疗一个病人动辄超过100万美元。即便仅用它来治疗致命的罕见遗传疾病，也会让医疗系统难以负担。用它来治疗更

普遍的疾病看起来昂贵得不可想象。

过去，一开始非常昂贵的新药价格会逐渐降下来。据波士顿咨询公司称，实验室制造的单克隆抗体这种很有用的蛋白质刚上市时价格高昂，但经过十年的发展，现在价格仅为当初的五十分之一。如果能让基因疗法实现其光明前景，它的价格就需要降得比这还要快。效率更高的光合作用要实现商业化也需要进一步投资。

所幸，新绿色革命的长期制造成本将会很低，因为植物会催生更多植物，而疗法却不能以同样的方式繁殖。基因疗法需要创新来降低成本，无论是通过生物反应器还是以某种全新的方式。如果能让新疗法变得更易负担，还需要尝试分期付款或按疗效收费等不同的支付机制。汇集全球需求来采购疗法也可能有助把价格拉下来。政府、慈善机构和私营部门可以在这方面开展有益的合作。

最后，监管机构还需要更快、更深入地了解帮助这些技术发挥潜力能给社会带来什么样的好处。没有适当或及时的规则制定，创新可能会萎靡不振。错误信息满天飞、益处迟迟感受不到和成本不断增加就阻碍了对转基因作物的监管。同样，尽管实验药物显然需要仔细审查，但监管者应该记住，如果没有实验药物，病人患上无法治疗的遗传疾病通常只剩等待死亡。科学让基因革命成为可能。现在，必须让这一革命蓬勃发展。■



Distressing debt

How China should handle its bad loans to poor countries

Time to work with Western creditors

HOW BIG is China's Belt and Road Initiative? It is hard to pin down a number. The programme has been running for nearly a decade, during which time China has financed hundreds of infrastructure projects in dozens of countries. These include railways in Africa, ports in Asia and roads in Latin America. President Xi Jinping has called it the "project of the century". The lofty rhetoric and opaque numbers fuelled fears that China was trying to reshape the world, by putting itself at the centre.

In one sense, it succeeded. The developing world is suffering a sovereign-debt crisis and China is at the heart of it. Buffeted by the pandemic, inflation and the war in Ukraine, dozens of countries involved in the Belt and Road Initiative are struggling to pay back loans from China and other creditors. Ethiopia and Zambia are among those restructuring their debts; Sri Lanka needs China's co-operation to do the same; in time, Cambodia, Kenya and Laos may follow. China's ruthlessly self-interested lending policies share some of the blame. The country must work with other creditors to resolve the crisis.

Such teamwork does not come naturally to China. An early test is Sri Lanka, where it has provided cash for ambitious projects. Some of these endeavours, such as big roads and expressways, seem to be worthwhile. But others have been costly flops. A new international airport in Hambantota, in the south, built with a \$190m loan from China, has at times struggled to keep the lights on. A Chinese-funded seaport nearby also looks like a dud. Struggling to service its debts, Sri Lanka's government handed control of the port, on a 99-year lease, to a state-backed Chinese firm in 2017.

White elephants alone did not cause the debt crisis. The blame lies mostly with Sri Lanka's government for slashing taxes in 2019 and with covid-19 for crushing tourism. But China provided a shovel to burrow deeper into debt. Early in the pandemic, as the island's debt woes mounted, some officials wanted to approach the IMF for a bail-out. But China stepped in, offering emergency loans to boost liquidity. That strategy failed spectacularly this year, when Sri Lanka ran out of dollars to pay for basic imports. By the time it approached the fund in April, its economy was in free-fall. Three months later big protests forced the president to flee.

The hope is that China learns the lesson Western creditors were taught in the 1980s and 1990s, when they repeatedly rescheduled loans, instead of writing them down, prolonging the economic pain in several developing countries. Better still if China learned to work with Western and other rich creditors, which are grouped together in the Paris Club and tend to coordinate sovereign-debt restructurings, often in tandem with the IMF. China has long resisted such efforts, resenting America's leading role in those organisations, as well as the club's commitment to consensus, transparency and "comparable treatment" for all creditors.

However, there are some reasons to be optimistic. China financed a splurge on infrastructure in Zambia similar to the one in Sri Lanka. And it frustrated debt-restructuring efforts after Zambia, too, ran into financial trouble. In 2020, though, it backed the "Common Framework" agreement between the G20 and the Paris Club to co-operate on debt treatments for poor countries. In July, after months of talks, China and other government creditors agreed to provide debt relief to Zambia in the first such deal under the framework. Now comes talk of China co-chairing a creditor committee with Japan and perhaps India to resolve Sri Lanka's debt.

| *China's stress test*

That would be welcome, as more tests are coming. China has scaled back

the Belt and Road Initiative. But it is still not clear if the crisis has prompted a serious rethink in Beijing. In the past China has claimed to offer a better model of development finance, free of the conditions that Western and multilateral lenders impose. It is true that those lenders need to improve their own practices. America, in particular, should not let geopolitical tensions hamper co-operation on debt relief. The onus, however, is now on China as the world's biggest official lender to take a more responsible approach to dispensing loans abroad—and to work with other creditors when things go bad. ■



【首文】令人担忧的债务

中国应如何处理对穷国的不良贷款

是时候与西方债权人合作了

中国“一带一路”倡议的规模有多大？对此很难给出一个确切的数字。这个项目已经实施了近十年，其间中国为几十个国家的数百个基建工程提供了资金，包括非洲的铁路、亚洲的港口以及拉丁美洲的公路。国家主席习近平称之为“世纪工程”。这样的豪言壮语和不透明的数据加剧了一种担忧：中国正试图让自己成为世界的中心以重塑世界。

从某种意义上说，它做到了。发展中国家正在遭受一轮主权债务危机，而中国处于危机的核心。受新冠疫情、通胀和乌克兰战争的冲击，几十个参与“一带一路”的国家目前难以偿还中国和其他债权人的贷款。埃塞俄比亚和赞比亚等国正在重组债务；斯里兰卡则需要中国的协作才能重组债务；柬埔寨、肯尼亚和老挝可能迟早会步其后尘。中国极度利己的贷款政策要负一部分责任。它必须与其他债权人合作来解决这场危机。

中国不会自然而然接纳这样的合作。早期的考验是斯里兰卡，中国为那里的一些宏大项目提供了资金。其中一些工程，如大型公路和高速公路，似乎很值得。但其他的却以失败告终且损失惨重。在南部的汉班托塔（Hambantota），用1.9亿美元的中国贷款新建的一座国际机场有时难以维持运营。附近的一个由中国提供资金建设的港口看起来也成了个摆设。由于无力偿还债务，斯里兰卡政府在2017年以99年租约的形式将汉班托塔港的控制权交给了一家由政府背景的中国公司。

华而不实的工程并不是债务危机的唯一推手。主要原因还是斯里兰卡政府在2019年实施了大幅减税措施，以及新冠疫情摧毁了旅游业。但中国的推波助澜让斯里兰卡债台越筑越高。疫情初期，随着斯里兰卡债务状况恶化，一些官员希望向国际货币基金组织（IMF）寻求纾困。但中国介入，提供了紧急贷款以增加流动性。今年，斯里兰卡耗尽了用于支付基本进口商品的美元外汇，这一策略遭遇惨败。到4月斯里兰卡向IMF寻求资助

时，该国经济已经处于自由落体状态。三个月后，斯里兰卡爆发大规模抗议活动，总统被迫出逃。

现在的希望是中国能吸取上世纪八九十年代西方债权人的教训。当时它们不断地重组债务而不是减记贷款，拖长了几个发展中国家的经济阵痛期。如果中国能学会与西方和其他富有债权国合作，那就更好了。这些债权国组成了巴黎俱乐部，经常在IMF的协作下协调主权债务重组。长期以来，中国一直抵触这样的努力，它厌恶美国在这些机构中的领导作用。它也抵触巴黎俱乐部致力于恪守共识、透明度以及确保所有债权人“待遇可比”。

不过，也有一些值得乐观的理由。像对斯里兰卡一样，中国也为赞比亚的一轮基建潮提供了资金。在赞比亚也陷入财政困境后，中国阻挠了债务重组的努力。不过在2020年，中国支持了20国集团和巴黎俱乐部之间达成的合作处理穷国债务的“共同框架”协议。经过几个月的谈判，中国和其他政府债权人在今年7月同意向赞比亚提供债务减免，这是该框架下的首个此类协议。目前有消息称，中国将与日本（或许还有印度）共同主持一个债权人委员会来解决斯里兰卡的债务问题。

| 中国的压力测试

随着更多考验到来，这样的做法将会受到欢迎。中国已经缩减了“一带一路”的规模。但仍不清楚这场危机是否已促使北京方面认真反思。中国过去曾声称提供更好的发展融资模式，不附带西方和多边贷款机构强加的条件。的确，这些贷款方需要改进自己的做法。尤其是美国，不应该让地缘政治紧张局势阻碍债务减免方面的合作。然而，作为世界上最大的政府贷款机构，中国现在有义务采取更负责任的对外放贷方式，并在出问题时与其他债权人合作。 ■



Dragons against hobbits

“Game of Thrones” v “Lord of the Rings”: a tale of old v new Hollywood

A century-old studio wages a big-budget war against a streaming upstart

HALF A BILLION dollars' worth of swordplay, sorcery and sex is on its way to a small screen near you. On August 21st Warner Bros Discovery launched “House of the Dragon”, a spin-off from its racy smash-hit, “Game of Thrones”, made at a reported cost of over \$150m. Hot on its heels, on September 1st Amazon Prime Video will release “The Rings of Power”, a more chaste but pricier drama based on the “Lord of the Rings” books. With a rumoured pricetag of \$465m, Amazon's offering will be the most expensive piece of television ever made.

This will make for an epic ratings battle. But it is also part of a longer-running war that pits old Hollywood studios against new streaming upstarts. Warner Bros will celebrate its 100th birthday next year. Amazon, which makes its money from e-commerce and cloud computing, launched its video sideline only five years ago. As the streaming wars intensify, each side believes it has the advantage.

Lately the dragons of old Hollywood have gained ground. Investors flocked to streaming specialists during lockdowns, but have lost interest as new subscribers have dried up. Netflix, which once talked of a potential market of 800m households, appears to have stalled at 220m and has seen its share price fall by 60% this year. On August 10th old Hollywood claimed a symbolic victory when Disney announced that it had overtaken Netflix, with 221m streaming subscriptions. That figure double-counts subscribers to Disney's various services, and ignores the fact that many are in low-paying countries like India. But it has banished any doubt that ageing studios can play the streaming game.

Hollywood's old hands are also refocusing on the business of making money, after two expensive years of chasing subscribers. Disney says its main streaming service, Disney+, will see its losses peak this year before turning a profit in 2024. A steep price rise, beginning in December, will help. On a recent earnings call David Zaslav, Warner's new boss, bluntly criticised the old approach of "spend, spend, spend and then charge very little". Warner will aim for its streaming business to generate a gross operating profit of \$1bn by 2025, he said. "If we do that, I don't really care what the [subscriber] number is...We want to make sure we get paid."

Old media formats will play a role. Cinemas, whose worldwide takings fell by 80% in 2020, are open again. The box office is still not what it was: Cineworld, the world's second-largest theatre chain, said on August 22nd that it was considering filing for bankruptcy. But Paramount, a 110-year-old Hollywood dragon, held back the release of "Top Gun: Maverick" during the pandemic and was rewarded in May with a box-office run of over \$1bn. Warner, which in 2021 released all its films on its streaming platform at the same time as they launched in cinemas, has gone back to exclusive theatre runs.

Theme parks are full again, too, with Disney's American ones generating record revenues and margins. Even broadcast and cable TV, long in decline, look like relative havens as the streaming business gets tougher. "We effectively have four, five or six cash registers," Mr Zaslav told investors. "And in a world where things are changing, and there's a lot of uncertainty and there's a lot of disruption, that's a lot more stable and a lot better than having one cash register."

That may be a convincing argument against an upstart like Netflix, which depends on streaming. The trouble for old Hollywood is that some of its new competitors have bigger and more varied cash registers. Warner's path to profit involves drastic cuts—it has already scrapped its streaming news

service, CNN+, and canned unfinished productions including “Batgirl”. Amazon shows no sign of belt-tightening. Besides “Rings of Power”, it recently bought Metro Goldwyn Mayer, the studio behind “James Bond”, for \$8.5bn and acquired rights to America’s National Football League for a reported \$1bn a year. Morgan Stanley, a bank, estimates that it will spend \$16bn on media content this year. Netflix spent \$14bn. Next year Amazon’s spending could reach \$20bn.

Unlike the old Hollywood dragons, some new streamers don’t even need to get paid, in Mr Zaslav’s words. Amazon Prime Video exists to keep people signed up to Prime, whose main benefit is free delivery of Amazon purchases. Apple’s steadily expanding TV+ service is geared towards keeping customers in its ecosystem of phones and computers, where the firm makes its real money. The video services from Amazon and Apple also provide real estate for advertising, a business in which both have ambitions to grow.

Old Hollywood is fighting back, offering viewers bigger “bundles” of content at a reduced cost. Warner plans to combine its main streaming service, HBO Max, with Discovery+ next summer. Disney is experimenting with discounted packages of services like ESPN+ and Hulu; some wonder if entry to its parks could one day form part of a Disney mega-bundle.

Yet Hollywood’s new rivals offer bundles of a different sort. Apple’s video vault is far smaller than that of Disney or Warner, but its “Apple One” package includes not just TV but music, games, storage, news and fitness. Amazon Prime comes with a similarly eclectic bunch of benefits. As households look for savings, deals like these may prove tempting.

That may be why some old Hollywood dragons are doing business with the upstarts. On August 15th Paramount announced a deal with Walmart, a giant retailer, in which members of Walmart+, the store’s answer to

Amazon Prime, will get free access to the Paramount+ streaming service. Walmart also sees media as a way to keep customers loyal to its main business. It recently added music to its bundle, via a deal with Spotify.

As competition for viewers intensifies, the battle between old and new Hollywood is proving as bloody as an episode of “Game of Thrones”. For consumers, who have more choice and more deals than ever, it is just as entertaining. ■



龙族对阵霍比特人

《权力的游戏》对《指环王》：新老好莱坞之战

百年电影公司向流媒体新贵发起一场高预算战争

耗资逾五亿美元的刀光剑影、魔幻和情色正涌向你身边的小屏幕。8月21日，华纳兄弟探索（Warner Bros Discovery）上线了《龙之家族》（House of the Dragon）。它是红极一时的大尺度剧集《权力的游戏》（Game of Thrones）的衍生剧，据说制作成本超过1.5亿美元。亚马逊Prime Video紧随其后，将在9月1日首播《力量之戒》（The Rings of Power），它改编自小说《指环王》，比《龙之家族》更保守圣洁，但制作成本更高。据传亚马逊这部剧投入了4.65亿美元，将成为有史以来最贵的电视剧集。

这将引发一场史诗级的收视率大战。但它也是一场更加旷日持久的战争的一部分——交战双方是好莱坞老牌电影公司和流媒体新贵。华纳兄弟明年将迎来自己的百岁生日。而靠电子商务和云计算赚钱的亚马逊五年前才推出视频业务。随着流媒体之战加剧，双方都认为自己占有优势。

最近，老牌好莱坞龙族占了上风。新冠疫情封锁期间，投资者纷纷涌向流媒体公司，但随着新订阅用户的枯竭，他们又失去了兴趣。奈飞曾大谈一个八亿户的潜在市场，不过其用户数似乎停滞在了2.2亿，今年的股价也下跌了60%。8月10日，迪斯尼宣布自己以2.21亿的流媒体订户数超过了奈飞，这是好莱坞老牌公司一次具象征意义的胜利。尽管这一数字重复计算了迪斯尼不同服务的订阅用户，且忽略了很多用户是来自印度等低收入国家的事实，但它打消了人们对日益老迈的电影公司能否玩转流媒体游戏的所有怀疑。

好莱坞的老将们在持续烧钱追逐订户两年后，现在开始重新聚焦在如何赚钱上。迪斯尼表示，其主要流媒体服务迪士尼+将在今年达到亏损峰值，在2024年实现盈利。12月开始的大幅提价将有助于盈利。在最近的一次财报电话会议上，华纳的新老板大卫·扎斯拉夫（David Zaslav）直言不讳

地批评“花钱如流水，收费一丁点”的老一套做法。他表示，华纳的目标是到2025年流媒体业务的总毛利润达到10亿美元。“如果我们做到这点，我真的不关心（订户）数是多少……我们要确保他们付钱。”

传统媒体形式将发挥作用。2020年全球影院收入下降了80%，现在它们又重新开放。票房依然不如从前：8月22日，全球第二大院线Cineworld表示正在考虑申请破产。不过，有着110年历史的好莱坞龙族派拉蒙

（Paramount）在疫情期间坚持不上映《壮志凌云2：独行侠》（Top Gun: Maverick）的做法收获了回报：今年5月上映后票房收入突破10亿美元。华纳去年在其流媒体平台同步推出了所有在影院上映的电影，现在又回归了以前仅限影院上映的做法。

主题公园也重新人满为患，美国本土迪士尼乐园的收入和利润都创下历史新高。随着流媒体业务处境变艰难，就连长期走下坡的广播电视和有线电视看起来也成了相对安全的避风港。“我们实际上有四、五、六台收银机，”扎斯拉夫对投资者说，“在一个充满变数的世界，有很多不确定性，有很多混乱和冲击，这比只有一台收银机要稳得多、好得多。”

这个说法在针对奈飞这样依赖流媒体的新贵时可能很有说服力。但好莱坞老牌公司的麻烦在于，它的一些新竞争对手拥有更大、更多样化的收银机。华纳的盈利之路需要大幅削减开支——它关闭了流媒体新闻服务CNN+，并叫停了包括《蝙蝠女》（Batgirl）在内的一些未完成影片的制作。亚马逊没有显示出任何紧缩开支的迹象。除了《力量之戒》，亚马逊最近还以85亿美元的价格收购了拥有《007》系列电影的米高梅电影公司（Metro Goldwyn Mayer），并以据说每年10亿美元的价格买下了美国职业橄榄球大联盟（National Football League）的赛事转播权。投行摩根士丹利估计，今年它将在媒体内容上花费160亿美元。奈飞花了140亿。明年亚马逊的支出可能达到200亿。

与老牌好莱坞龙族不同，一些新兴流媒体玩家甚至不需要——套用扎斯拉夫的话说——让人付钱。亚马逊Prime Video的创建是为了让人们注册Prime会员，而Prime会员的主要好处是在亚马逊购买商品享受免费送货。

苹果稳步扩展的TV+服务旨在将客户留在自己的手机和电脑生态系统中，这些才是苹果真正赚钱的地方。亚马逊和苹果的视频服务还为广告业务提供了空间，两家公司都有大力发展广告业务的雄心。

龙族正在反击，以折扣价格向观众提供有更多内容“捆绑包”。华纳计划在明年夏天将其主要流媒体服务HBO Max与迪士尼+合并。迪士尼正在尝试提供包括ESPN+和Hulu等服务的优惠套餐。一些人琢磨着哪天迪士尼会不会推出涵盖它的乐园门票的超大捆绑包。

但好莱坞的新对手提供的是另一种类型的捆绑包。相比迪士尼或华纳，苹果的视频库小得多，但它的Apple One套餐不仅包括电视，还包括音乐、游戏、存储、新闻和健身等服务。亚马逊Prime也把类似的一堆五花八门的福利整合在一起。随着很多家庭开始节俭过日子，这样的套餐可能会很有吸引力。

这或许就是一些好莱坞老牌龙族与新贵联手的原因。8月15日，派拉蒙宣布与零售巨头沃尔玛达成一项协议。根据协议，沃尔玛+（为对阵亚马逊Prime而设立）会员可以免费使用派拉蒙+流媒体服务。沃尔玛也认为可以用媒体内容来帮助保持顾客对其主营业务的忠诚度。不久前它与Spotify达成一项交易，把音乐加入了自己的捆绑包。

随着对观众的抢夺日趋激烈，新老好莱坞之战的血腥尺度仿佛是出自《权力的游戏》中的某集。而对于拥有了空前多的选择和优惠的消费者来说，这就和看剧一样叫人兴奋愉悦。■



There will be blood

An epic history of oil from ancient times to the first world war

There are few clean hands in "A Pipeline Runs Through It"

A Pipeline Runs Through It. By Keith Fisher. Allen Lane; 768 pages; £35

IN 1908 DRILLERS working for Weetman Pearson hit a gusher. Pearson, a British industrialist, had done a deal with the anti-American government of Mexico for a 50-year oil concession that covered much of the state of Veracruz. From a depth of 1,830 feet (558 metres), the Dos Bocas well exploded into a broiling fountain of oil that rose 1,000 feet into the air.

The ensuing fire raged uncontrolled for 57 days, spilling more than 10m barrels of oil and leaving a toxic environmental legacy that persists today. A geologist at the site observed: "What had been lush monte [bush] was now a gaunt spectre of dead trees. The air stunk with the smell of rotten eggs. There was no sign or sound of animal, bird or insect life...It smelled and looked like I imagined hell might look and smell." The oilfields opened up by this catastrophe were so prolific and profitable that they became known, apparently without irony, as the "Golden Lane".

As Keith Fisher shows in "A Pipeline Runs Through It", a sprawling, painstakingly researched history of oil from the Palaeolithic era to the first world war, black gold has been as much a curse as a blessing for the people on whose land it has been found. Oil has always been a dirty business, both literally and metaphorically.

Mr Fisher begins with a slightly plodding survey of the uses found in bygone eras for the different kinds of oil that seeped from the ground. It was an adhesive for toolmaking, a waterproofing agent for boats and roofs, a medicinal cure and a lubricant. The Byzantines chucked a napalm-like

substance, known as Greek Fire, over the walls of besieged cities. The book gets into its stride when it reaches the late 18th century. Then the extirpation of Native American nations paved the way for the development, just over 50 years later, of the “oil region” of Pennsylvania and New York states. It was there that large-scale industrialised oil production first occurred.

The soaring demand for oil was driven mainly by its use for lighting (after being refined into kerosene). It burned cleaner, brighter and with less smell than other oils, such as those derived from coal or whales. The oil rush began in 1859 along what became known as Oil Creek, near Titusville, Pennsylvania, when an entrepreneur called Edwin Drake became the first American to drill for oil successfully. As wildcatters rushed to the region, small refineries started popping up all over the place. Railway companies cashed in by providing the only route to market until pipelines, which required large amounts of capital, could be constructed.

Into this Wild East of desperate competition—and prices that fluctuated madly as capacity grew either too fast or too slowly—stepped John D. Rockefeller, whose Standard Oil set out to control the industry through a process of “combination”, or monopolisation. Such was Standard’s financial muscle and legislative clout that competitors sold it their assets before being driven out of business. By controlling pipelines and refineries, Rockefeller could also dictate terms to producers.

| *There will be blood*

Standard’s grip on what was rapidly becoming a global market triggered a response from European colonial powers, which saw the dangers of becoming reliant on imports from America or Russia. With no less violence or ruthlessness than their American counterparts, they set about exploiting existing and newly acquired colonies to correct the imbalance. The British turned to the Indian subcontinent and then to Persia, the Dutch to the East

Indies.

The most intense competition was between Standard, as it sought concessions in the Far East, and the emerging behemoth, Royal Dutch Shell. Nowhere was the pursuit of oil bloodier than in Aceh at the northern tip of Sumatra. In 1896 Dutch forces were sent to open up the area for exploitation through “merciless chastisement” of the local population. Atrocities in Aceh became routine. Over the next 40 years up to 100,000 Acehnese would be slaughtered for the sake of oil. Hendrikus Colijn, an officer with a well-earned reputation for brutality, described his approach to his work in a letter home to his wife:

I saw a woman, with a child about half a year old in her left arm and a long lance in her right hand, charging towards us. One of our bullets killed both mother and child. From then on we could grant no more mercy. I had to gather together 9 women and 3 children, who were begging for mercy, and they were all shot. It was unpleasant work, but there was no alternative.

These horrors did not harm Colijn’s career. He became head of Royal Dutch Shell and prime minister of the Netherlands.

By the beginning of the 20th century, with both the refinement of the internal-combustion engine and the realisation by the navies of the great powers that their ships could go farther and faster with boilers fuelled by oil rather than coal, reliable access to oil in times of war became a major security concern. Mr Fisher writes especially well about the maniacal drive of Admiral “Jackie” Fisher (no relation) to shift the Royal Navy from coal to oil propulsion with the backing of Winston Churchill, at the time the First Lord of the Admiralty. To ensure that the great Dreadnought battleships could still rule the waves, in 1914 the House of Commons voted overwhelmingly for the “socialist” solution of nationalising the Anglo-Persian Oil Company (which would later become BP).

It was in the nick of time. A few weeks later Archduke Franz Ferdinand was killed in Sarajevo. More than a century on, and despite faltering attempts to stall climate change through decarbonisation, the war in Ukraine is a reminder of the world's continuing dependence on oil.

This book has its faults. At times the narrative is overloaded with detail, and the author seems reluctant to flesh out the many extraordinary (and rapacious) characters who populate the story of oil. But it is nevertheless a compelling read, crammed with eyewitness accounts, and an immensely valuable guide to a great and terrible industry. ■



血色黑金

从远古到一战的石油史诗

在《管道穿行》中，没有几双手是干净的【《管道穿行》书评】

《管道穿行》，基思·费舍尔著。艾伦莱恩出版社，768页，35英镑。

一九〇八年，英国实业家韦特曼·皮尔逊（Weetman Pearson）手下的钻井工人钻探到一口油井。此前他与反美的墨西哥政府谈妥协议，获得了韦拉克鲁斯州（Veracruz）大部分地区为期50年的石油开采权。多斯博卡斯油井（Dos Bocas）在1830英尺（558米）深处爆炸，炙热的石油喷涌而出，窜上1000英尺高。

随之而来的熊熊烈火持续烧了57天，泄漏的石油超过1000万桶，对环境造成的毒害延续至今。一位去过现场的地质学家记述道：“原本郁郁葱葱的灌丛如今只剩一片荒凉破败的枯枝朽木。空气中弥漫着臭鸡蛋的味道。没有任何鸟兽昆虫的踪迹或声音……这里的气息和景象犹如我想象中的地狱。”由这场灾难打开的油田产量极高、利润丰厚，因而得名“黄金巷”，似乎并不带讽刺意味。

基思·费舍尔（Keith Fisher）所著的《管道穿行》（A Pipeline Runs Through It）对从旧石器时代到第一次世界大战的石油史做了庞杂而艰辛的研究。正如他在书中展现的，对于在自家土地上发现了石油的人们来说，这种“黑金”既是福也是祸。无论从字面上还是在隐喻上，石油一直都是个肮脏的行业。

费舍尔先是略嫌拖沓地概述了古时候人们如何利用从地下渗出的各种石油。石油曾用作制造工具时的粘合剂，也曾被用作船只和屋顶的防水涂料、药品及润滑剂。在被围城攻打时，拜占庭人会向城墙外投掷一种名为“希腊火”的类似凝固汽油弹的东西。写到18世纪末时，这本书才真正切入正题。那时美洲原住民被屠杀灭绝，为50多年后宾夕法尼亚州和纽约州发展“石油区”开辟了道路。正是在那里，人类首次开展了大规模的工业化石

油生产。

石油需求飙升主要是受照明用途（被提炼成煤油后）推动的。相比从煤或鲸鱼等来源提取的油脂，石油烧起来更清洁、明亮，气味也更小。石油热潮始于1859年宾夕法尼亚州泰特斯维尔（Titusville）附近人称“油溪”的地区，一位名叫埃德温·德雷克（Edwin Drake）的企业家成为首位成功钻探出石油的美国人。随着投机勘探者涌向该地区，小型炼油厂开始随处可见。直至建造起耗资庞大的输油管道之前，铁路公司提供了油品输往市场的唯一路径，从中获利。

在这竞争白热化的“狂野东部”，产能增长不是太快就是太慢，油价疯狂波动，然后约翰·戴维森·洛克菲勒（John D. Rockefeller）登场了。他创立的标准石油公司（Standard Oil）开始通过一系列所谓的“结合”（也就是垄断）控制整个行业。标准石油财力雄厚，还有很强的立法影响力，让竞争对手在被逼出局前把资产都卖给了它。通过控制输油管道和炼油厂，洛克菲勒还可以对生产商发号施令。

| 血色黑金

标准石油对一个快速实现全球化的市场的掌控引发了欧洲殖民大国的关注，它们察觉到了依赖美国或俄国进口石油的危险。为扭转失衡状态，这些国家开始以不亚于美国的无情暴力开采既有的和新夺取的殖民地上的石油资源。英国人把手伸向印度次大陆以及波斯，荷兰人则转向东印度群岛。

最激烈的竞争发生在向远东地区寻求开采权的标准石油和新兴巨头荷兰皇家壳牌之间。在苏门答腊岛北端的亚齐（Aceh），石油之争最是血腥。1896年，荷兰派军队到该地区，通过“残酷惩戒”当地居民为开采石油铺路。暴行在亚齐成了家常便饭。在接下来40年里，多达十万亚齐人因石油遭屠杀。以残暴著称的军官亨德里克斯·科莱恩（Hendrikus Colijn）在给家乡的妻子的信中说到了自己的行径：

我看到一个女人向我们冲过来，左手抱着个大约半岁的孩子，右手拿着一

支长矛。我们连发数枪，其中一发子弹把这对母子都打死了。从那时起，我们再也不能手下留情了。我不得不把九个女人和三个小孩抓到一起，尽管他们不停乞求开恩，最后还是给全部击毙了。这是件脏活，但我们别无选择。

这些可怖经历并没损伤科莱恩的职业生涯。他后来执掌荷兰皇家壳牌，还成了荷兰首相。

到了20世纪初，内燃机技术得到改进，与此同时强国的海军都意识到，如果锅炉以石油而非煤作燃料，他们的舰船可以航行得更远更快，这使得在战争时期确保石油供应成了重大的国家安全问题。费舍尔在书中写到，在时任英国第一海军大臣的丘吉尔的支持下，海军上将“杰基”·费舍尔（“Jackie” Fisher，和作者没有亲缘关系）极力推动皇家海军从使用煤炭转向石油。这一段写得尤其精彩。为确保伟大的“无畏”号战舰仍能称霸海洋，1914年，英国下议院以压倒性多数票通过了把英波石油公司（Anglo-Persian Oil Company，BP的前身）国有化的“社会主义”解决方案。

这赶上了关键时刻。几周后，弗朗茨·斐迪南大公（Archduke Franz Ferdinand）在萨拉热窝遇刺。如今，一个多世纪过去了，虽然人们为阻止气候变化磕磕绊绊地推行脱碳计划，但乌克兰战争提醒我们世界依然依赖石油。

这本书有不足之处。有时叙述太过巨细靡遗，而对于石油史上许多非凡的（以及强取豪夺的）人物，作者又似乎不愿详加描写令其血肉饱满。但书中有大量的目击者忆述，读来引人入胜，同时也是对一个既伟大又可怕的行业极其宝贵的指南。■



Air travel

Ways to make aviation fuel green

Airlines hope to become carbon neutral by 2050

TRAVELLING BY AIR is by no means the biggest source of anthropogenic greenhouse-gases. At the moment, it contributes about 2.5% of them. But, after a covid-induced dip, air travel is once again growing (see chart), and its emissions are high-profile and hard to deal with. For short-range, small-capacity planes batteries show some immediate promise. But for bigger aircraft the technofantasy of using compressed hydrogen (made from green sources, natch) either as jet fuel in its own right, or to run fuel cells which then drive electric motors, is likely to remain just that—a fantasy—for decades.

Hence the popularity of the idea of sustainable aviation fuel (SAF). This magical substance would match existing fuel in all relevant parameters and would thus, in the argot, be a “drop-in” replacement for the kerosene currently burned by planes. But instead of being distilled from crude oil, SAF would be manufactured either directly or indirectly from carbon dioxide.

Ideally, this CO₂ will have come recently from the atmosphere, so that when it returns to the air no net greenhouse effect is created. At minimum, though, it will be extracted from the exhaust of an industrial process, enabling it at least to substitute for fossil-fuel emissions elsewhere before it is released.

Do this at a price competitive with stuff from a refinery and the world is your oyster. Airlines have already undertaken some 450,000 flights using SAF as part of the fuel mix. The industry aims to be carbon neutral by 2050, and so far SAF seems the only practical way to get there. But making SAF is

an uphill task. Stripped to its chemical essentials it means taking the equivalent of engine exhaust and turning it into something resembling what went into that engine in the first place. This requires “fixing” the carbon of carbon dioxide into big energy-rich molecules. Not surprisingly, the result is around three times as costly as ordinary jet fuel.

Such SAF as has so far made it to market relies on photosynthesis to do the carbon fixing. It is derived from discarded cooking oil and animal fats, the triglyceride molecules of which trace their existence to the action of sunlight on chlorophyll.

To make SAF, triglycerides are hydrotreated, an established way of producing biodiesel for ground transport. A triglyceride molecule consists of three hydrocarbon tails attached to an oxygen-containing head. Hydrotreating combines the oxygen with hydrogen, to yield water. This liberates the tails and turns the head into a molecule of propane. The liberated tails can then be processed into drop-ins.

| *Boarding now*

At the moment, the biggest producer of hydrotreated SAF is Neste, a Finnish firm. It is expanding a biodiesel plant in Rotterdam for SAF production and also enlarging a purpose-built one at Porvoo, in its home country. Neste aims, by the end of 2023, to be turning out 1.9bn litres of SAF per year—some 15 times total world production in 2021 (though still less than 2% of global jet-fuel consumption). A milestone of sorts was reached in July when American Airlines took delivery of the first batch of SAF to be verified as green by CORSIA, the Carbon Offsetting and Reduction Scheme for International Aviation, which benchmarks aviation-emission standards.

Neste, though, is not the only company using hydrotreating to make SAF from recycled cooking oils and fats. In America a firm called World Energy

employs a former oil refinery in Paramount, California, to do something similar. Paramount was, indeed, the first plant to make SAF commercially, having been converted to do so in 2016 by Bryan Sherbacow, a green entrepreneur. World Energy, to which Mr Sherbacow sold the plant in 2018, has teamed up with Air Products, a specialist in industrial gases, and Honeywell, an engineering firm, to expand the operation. By 2025, it expects to make around 1.3bn litres of SAF a year. Mr Sherbacow himself, meanwhile, has set off in a different direction. This is to widen the range of waste materials that can be turned into SAF.

A big obstacle to expanding the triglyceride approach to SAF is the supply of raw materials. Adding value to catering waste is something all can applaud. But for it to make a serious contribution to the jet-fuel market would mean buying fresh oils and fats that might otherwise be used as food. This would raise prices and encourage the spread of oil-palm plantations, both of which will bring problems of their own.

Mr Sherbacow's new project, Alder Fuels, is on the case. Alder's raw material is also waste—but in this case, leftovers from forestry and agriculture. Such "biomass" consists mainly of cellulose, hemicellulose and lignin—three structural polymers that act, in essence, as a plant's skeleton.

Structural polymers cannot be processed by anything resembling hydrotreating. Instead, Alder uses pyrolysis, which breaks the material concerned into smaller molecules by applying heat. The result is condensed into a hydrocarbon-rich liquid that the firm calls greencrude. This can be processed into SAF in existing refineries and Boeing, America's biggest aircraft maker, announced in July that it would use some of its planes to test and qualify the result. Alder hopes to begin commercial production in 2024.

| *Waste not, want not*

One problem with using biomass as raw material is that it is bulky, and thus expensive to gather, transport and store. To get around this, Alder is looking at a “hub-and-spoke” system, in which the processing plants are at the ends of the spokes, near sources of biomass, and the resulting greencrude is transported in tankers to a refinery at the hub.

According to Alder’s calculations, forestry and agricultural waste are, if processed this way, abundant enough in America to supply three-quarters of the country’s current demand for aviation fuel, with no need to establish new plantations, or to compete with food production. Even so, others propose yet a different strategy. This is to fix carbon dioxide directly in an industrial plant, rather than relying on biology to do the job.

The most popular approaches to such direct fixation are called power-to-liquid processes. These yield what are known as e-fuels (an abbreviation of electrofuels, as production relies, at least in part, on electricity). Power-to-liquid processes vary. But all have in common the creation of a mixture of hydrogen and carbon monoxide, known as syngas.

The value of syngas is that, at appropriate temperatures and pressures, and in the presence of suitable catalysts, its constituents react to yield hydrocarbons and water. This is called the Fischer–Tropsch process, after the German chemists who invented it in the 1920s, and it was used by Germany during the second world war to convert coal into liquid fuels, to make up for the country’s lack of access to petroleum.

That wartime approach involved the partial oxidation of the coal to create carbon monoxide. But this ingredient can also be made by the partial reduction of CO₂—hence the interest in its use for SAF. The CO₂ in question could come from many sources. Some dream of plucking it directly from the atmosphere, using what is known as direct air capture (DAC) to filter it

out. Others, more pragmatically, suggest extracting it as a by-product from methane-generating biodigesters, or from fermentation plants, such as breweries.

If renewable electricity is then used to make the hydrogen, by electrolysing water, the resulting e-fuel is pretty green. One country with abundant hydro and wind power which can be taken advantage of in this way is Norway. And it is here that a consortium called Norsk e-Fuel is building a DAC plant to produce SAF. Production of 12.5m litres a year should start in 2024.

Another source of renewable power is the sun. Synhelion, a Swiss firm, employs a field of mirrors to reflect sunlight to a receiver at the top of a tower. This heats a transfer fluid in the receiver to a temperature in excess of 1,500°C and that fluid, in turn, powers a reaction chamber which produces syngas by reducing water to hydrogen and CO₂ to carbon monoxide. To start with the company is using a nickel-based catalyst and taking gas from a biomass plant, although it is developing other processes and will later add DAC to the system. By having some of the transfer fluid pass through a heat store, to garner a proportion of its thermal load for later use, the process should be able to operate round the clock.

On August 17th Synhelion announced that an experimental plant was producing syngas at “an industrial scale”, and it is now putting the finishing touches to a facility near Cologne, Germany, from which it hopes, next year, to deliver SAF to airlines in the Lufthansa group. If all goes well it will open a further plant in Spain, in 2025, to take advantage of higher levels of sunshine there. By 2030, with additional plants coming on stream, the firm’s output could rise to some 850m litres a year—enough to meet around half the needs of Swiss carriers. The target, by 2040, is 50bn litres a year. That, if it came to pass, would make a serious dent in the jet-fuel market

| *Jetting to a greener future*

In a separate project, Synhelion has linked up with CEMEX, a Mexican company that is one of the world's biggest producers of cement. Part of cement-making involves heating limestone to drive off CO₂. This fact makes the industry responsible for about 8% of anthropogenic emissions of the gas. The CO₂ in question is pretty pure, though, and thus itself ideal as a raw material. Having tested the idea successfully in Spain, the two companies aim to build a trial plant at one of CEMEX's works. Though making e-fuel in this way would not be as green as plucking the CO₂ concerned from the atmosphere, it would extract at least some environmental value from a product that would otherwise be entirely waste.

Oil companies are also keen to get in on the act. Repsol, a Spanish firm, has teamed up with Saudi Aramco, Saudi Arabia's petroleum giant, to build a plant in Bilbao that will make fuel not just for planes, but also for cars, lorries and boats, using green hydrogen and CO₂ fed from a nearby oil refinery. This plant, planned to open in 2024, will employ a catalytic process developed by Johnson Matthey, a British chemicals company, to do the Fischer-Tropsching.

Further down the track, a third approach to making SAF, distinct from employing organic waste or the Fischer-Tropsch process, is to use biotechnology. One idea which has been around for a while is to utilise photosynthesis directly, by engineering single-celled algae to make conventional drop-ins. Another, suggested in July, is a decidedly unconventional bioengineered drop-in based on a molecule made by bacteria to defend themselves against fungi. So far, though, these proposals are confined to the laboratory.

One way or another, then, the technology for making green aircraft fuels does seem to be coming into existence. Nor need such alternatives replace

standard jet fuel completely to meet the airlines' carbon-neutral-by-2050 target, says Sebastian Mikosz, head of environment and sustainability for IATA, the trade group which represents most of the airline industry. The group's calculations suggest SAF could account for 65% of aviation's carbon mitigation, with the rest coming from electric and hydrogen-powered aircraft, more-efficient airline operations, offsetting emissions and carbon capture. Yet that still requires 450bn litres of SAF a year by the middle of the century.

Scaling up SAF production to such a level may need government nudging. To this end, Joe Biden's administration in America has announced tax credits and other incentives for SAF production as part of the country's new spending bill. Instead of carrots, the EU is using a stick. Member states are being asked to impose SAF targets at individual airports. One proposal suggests these would rise from 2% in 2025 to 85% by 2050. Get the incentives right to expand production and reduce costs, though, and a point may yet come when the environmentally sensitive can board an aircraft with a clear conscience. ■



航空旅行

让航空燃料更环保的办法

航空公司希望到2050年实现碳中和【深度】

航空旅行绝对算不上人为温室气体的最大排放源。目前，它在其中的占比大约是2.5%。但在经历了新冠疫情导致的下降之后，航空旅行再度回升（见图表），而且航空旅行产生的排放是个广受关注却又难以解决的问题。对于短程飞行的小型飞机，电池也许在短期内就会显现一定的前景。但对于大型飞机来说，使用压缩氢气（当然得是用绿色能源制造的）直接作燃料，或用它运作燃料电池以驱动电动机的科技幻想很可能在几十年内都只是个幻想。

可持续航空燃料（SAF）这一创意由此风行。这种神奇的物质将能在所有重要参数上与现有燃料媲美，因此，用行话来说，它将是目前航空煤油的“即用型”替代品。但SAF不是通过原油蒸馏得来，而是直接或间接地由二氧化碳生产而来。

理想情况下，这些用来生产SAF的二氧化碳应该是新近从大气中捕获的，这样当它们回到大气中时就不会产生净温室效应。而它们最起码将可以从工业废气中提取，这样至少在它们重新释放之前替代了其他地方的化石燃料排放。

如果这种SAF的价格可与炼油厂的产品相竞争，那世界就尽在你掌握了。航空公司已经使用SAF作为燃料的一部分进行了约45万次飞行。该行业力求到2050年实现碳中和，到目前为止，SAF似乎是实现这一目标的唯一可行方法。但生产SAF是一项艰巨的任务。单从化学原理看，生产SAF就是获取类似发动机废气的物质，把它转化成与最初进入发动机的燃油差不多的东西。这就需把二氧化碳中的碳“固定”到富含能量的大分子中。这样下来，SAF的价格是普通航空燃料的三倍左右也就不足为奇了。

目前已经上市的SAF依靠光合作用来固定碳。它以厨余油和动物油脂为原

料，而这些原料中的甘油三酯分子源自阳光对叶绿素的光合作用。

生产SAF需要对甘油三酯做加氢处理，这是一种生产地面运输用生物柴油的成熟技术。甘油三酯分子由一个含氧的头部以及与其相连的三条碳氢化合物尾巴组成。加氢处理让氧与氢结合，生成水。这就释放了尾部，把头部变成了丙烷分子。释放出来的尾部可以被加工成即用型燃料。

| 正在登机

目前，加氢精制SAF的最大生产商是芬兰的耐斯特（Neste）公司。该公司正在荷兰鹿特丹扩建一家生物柴油工厂用来生产SAF，同时也在本国的波尔沃（Porvoo）扩建一家专门生产SAF的工厂。耐斯特的目标是到2023年底每年生产19亿升SAF——大约是2021年全球总产量的15倍（尽管仍然不到全球航空燃料消耗量的2%）。7月，耐斯特向美国航空（American Airlines）交付了首批经国际航空碳抵消与减少计划（Carbon Offsetting and Reduction Scheme for International Aviation，简称CORSIA，是航空排放标准的基准）绿色认证的SAF，算是达到了一个里程碑。

不过，耐斯特并不是唯一使用加氢处理技术从回收的厨余油和动物油脂中生产SAF的公司。在美国，一家名为世界能源（World Energy）的公司利用位于加州派拉蒙（Paramount）的一家旧炼油厂来做类似的事。事实上，派拉蒙这家工厂是第一家商业化生产SAF的工厂，在2016年由环保企业家布莱恩·谢巴科夫（Bryan Sherbacow）改造而成。2018年，世界能源公司从谢巴科夫手中收购了该工厂，并与工业气体公司空气产品（Air Products）和工程公司霍尼韦尔（Honeywell）合作，扩大生产。它预计到2025年SAF年产量将达到13亿升左右。与此同时，谢巴科夫自己另辟蹊径，致力于拓宽可转化为SAF的废弃物的范围。

推广用甘油三酯制取SAF的一大障碍是原材料供应。为餐厨垃圾增加价值是人人称道的事情。但如果要让它能对航空燃料市场做出重大贡献，就意味着要购买原本可能被用作食物的新鲜油脂。这会推高新鲜油脂的价格，同时会刺激油棕榈种植园的扩张，而这两者都会带来各自的问题。

谢巴科夫的新公司Alder Fuels正在着手解决这个问题。Alder使用的原材料也是废弃物——不过是农林废弃物。这种“生物质燃料”主要由纤维素、半纤维素和木质素组成——这三种结构性聚合物从本质上说是植物的骨架。

结构性聚合物不能用任何类似加氢处理的技术来加工。因此，Alder使用的是热解技术，通过加热将这些材料分解成更小的分子。最后这些材料会浓缩成一种富含碳氢化合物的液体，该公司称之为“绿色原油”。“绿色原油”可以在现有的炼油厂被加工成SAF。美国最大的飞机制造商波音公司在7月宣布将在部分飞机上测试这种燃料，看它是否达标。Alder希望在2024年开始商业化生产。

| 俭以防匮

使用生物质燃料作原料的一个问题是它们体积庞大，因此收集、运输和储存的成本都很高。为了解决这个问题，Alder正在研究一种“轴辐式”运输系统，其中加工厂位于辐条的末端，靠近生物质燃料的来源地；而生产出的“绿色原油”则会用罐车运输到位于轴心的精炼厂。

根据Alder的计算，若以这种方式生产，美国的农林废弃物足以满足本国目前四分之三的航空燃料需求，不需要新建种植园，也不需要和食品生产争抢原料。尽管如此，还是有其他人提出了不同的策略——直接在工厂里固定二氧化碳，而不依靠生物学过程。

直接固碳的最常见做法被称为电转液技术。其产品叫作e燃料（电燃料的缩写，因为它的生产多少要依靠电力）。电转液技术有很多种，但它们有个共同点，就是生成一种由氢和一氧化碳混合而成的合成气。

合成气的价值在于，在适当的温度和压力下，再加入合适的催化剂，其中的成分就会发生反应，生成碳氢化合物和水。这被称为费-托法（费歇尔-托罗普歇法），以上世纪20年代发明这种工艺的两位德国化学家的名字命名。德国在二战期间使用这种方法把煤炭转化为液体燃料，以弥补本国获取原油不足。

战时的这个方法包括将煤炭部分氧化，生成一氧化碳。但一氧化碳也可以

通过部分还原二氧化碳制得——因此人们对用二氧化碳生产SAF产生了兴趣。所用的二氧化碳可能有很多种来源。有些人梦想直接从大气中提取二氧化碳，使用所谓的直接空气捕获（DAC）技术将它过滤出来。另外一些人更务实一些，建议从制取沼气的生物分解设备或啤酒厂等发酵工厂中提取作为副产品的二氧化碳。

如果接下来用可再生电力进行电解水制氢，生产出来的e燃料就非常环保了。挪威拥有丰富的水力和风能，可用于生产e燃料。一家名叫Norsk e-Fuel的联合企业正在挪威建造DAC工厂，用于生产SAF。预计2024年开始每年可生产1250万升SAF。

另一种可生产SAF的可再生能源是太阳能。瑞士公司Synhelion用大量镜子将阳光反射到塔顶的接收器上。接收器中的传热流体被加热到超过1500°C，进而为反应室提供热能，将水还原成氢，将二氧化碳还原为一氧化碳，从而产生合成气。一开始，该公司使用镍基催化剂，并从生物质燃料工厂捕获气体——尽管它也在研发其他技术，而且以后会在系统中加入DAC装置。通过让一些传热流体流过热存储器，可以把一定比例的热负荷存储下来留待以后再使用，这一过程应该能够全天候进行。

8月17日，Synhelion宣布一家实验工厂正在以“工业化规模”生产合成气，德国科隆附近的一座工厂也在做最后的收尾工作，希望明年可以从这里向汉莎集团的航空公司交付SAF。如果一切顺利，它将于2025年在西班牙再开设一家工厂，以利用那里更强烈的阳光。随着更多工厂投产，到2030年，Synhelion的年产量将达到约8.5亿升——足以满足瑞士本国航空公司一半的需求。它的目标是到2040年每年生产500亿升。如果真能实现，将大大冲击航空燃料市场。

| 飞向更环保的未来

在另一个项目中，Synhelion与墨西哥的西麦斯（CEMEX）合作，后者是全球最大的水泥生产商之一。水泥生产中有一个环节需要加热石灰石来排出二氧化碳。这使得该行业在人为二氧化碳排放中的占比达到约8%。不过水泥生产中所产生的二氧化碳纯度相当高，因此是理想的原材料。这一想

法在西班牙测试成功之后，两家公司打算在西麦斯的一家工厂内建立一间试验工厂。虽然用这种方法制造e燃料不会像从大气中提取二氧化碳那样环保，但至少可以从一种原本完全是废弃物的产品中获得一些环境价值。

石油公司也积极参与进来。西班牙石油公司雷普索尔（Repsol）与沙特阿拉伯石油巨头沙特阿美（Saudi Aramco）合作，将在西班牙的毕尔巴鄂（Bilbao）建造一座工厂，建成后将使用绿氢和取自附近炼油厂的二氧化碳，为飞机同时也为小汽车、卡车和船舶等制造燃料。该工厂计划于2024年投产，届时将采用英国化工公司庄信万丰（Johnson Matthey）开发的催化工艺来进行费-托法合成。

展望未来，还有第三种生产SAF的方法，它使用生物技术，而不是利用有机废弃物或使用费-托法。一个已经酝酿了一段时间的想法是直接利用光合作用，通过改变单细胞藻类的基因结构来制造常规的即用型燃料。7月才提出的另一个想法基于一种由细菌为抵御真菌而生成的分子，利用生物工程技术来生产一种绝对非常规的即用型燃料。不过，到目前为止，这些方案还都处于实验阶段。

无论如何，制造环保航空燃料的技术看来的确正在成为现实。世界大多数航空公司都加入了国际航空运输协会（IATA），该行业组织的环境与可持续发展事务负责人塞巴斯蒂安·米科斯（Sebastian Mikosz）表示，要实现航空公司2050年碳中和的目标，也不需要完全用这种替代品取代标准航空燃料。该组织的计算表明，SAF能够承担航空业65%的碳减排，其余部分则来自电动和氢动力飞机、更高效的航空运营、碳排放抵消和碳捕获。不过，这意味着到本世纪中叶每年还将需要4500亿升SAF。

要把SAF产量提高到这样的水平可能需要政府提供些许助力。为此，拜登政府已宣布在新出台的支出法案包含对SAF生产的税收抵免和其他激励措施。欧盟用的是大棒，而不是胡萝卜。其成员国被要求在各个机场强制推行SAF目标。一项提案建议到2050年把SAF的使用比例从2025年的2%上升到85%。不过，如果采取适当的激励措施来扩大SAF的生产并降低其成本，那么，环保敏感人士能够心安理得地登上飞机的那一刻可能终将到

来。■



Bartleby

When to trust your instincts as a manager

Deliberation does not always makes sense

HUMANS HAVE been honed over millions of years of evolution to respond to certain situations without thinking too hard. If your ancestors spotted movement in the undergrowth, they would run first and grunt questions later. At the same time, the capacity to analyse and to plan is part of what distinguishes people from other animals. The question of when to trust your gut and when to test your assumptions—whether to think fast or slow, in the language of Daniel Kahneman, a psychologist—matters in the office as much as in the savannah.

Deliberative thinking is the hallmark of a well-managed workplace. Strategic overhauls and budget discussions are built on rounds of meetings, memos, formulas and presentations. Processes are increasingly designed to stamp out instinctive responses. From blind screening of job applicants to using “red-teaming” techniques to pick apart a firm’s plans, rigour trumps reflex.

Yet instinct also has its place. Some decisions are more connected to emotional responses and inherently less tractable to analysis. Does a marketing campaign capture the essence of your company, say, or would this person work well with other people in a team? In sticky customer-service situations, intuition is often a better guide to how to behave than a script.

Gut instincts can also be improved (call it “probiotic management”). Plenty of research has shown that intuition becomes more unerring with experience. In one well-known experiment, conducted in 2012, volunteers were asked to assess whether a selection of designer handbags were

counterfeit or real. Some were instructed to operate on instinct and others to deliberate over their decision. Intuition worked better for those who owned at least three designer handbags; indeed, it outperformed analysis. The more expert you become, the better your instincts tend to be.

However, the real reason to embrace fast thinking is that it is, well, fast. Instinctive decision-making is often the only way to get through the day. Researchers at Cornell University once estimated that people make over 200 decisions a day about food alone. The workplace is nothing but a succession of choices, a few big and many small: what to prioritise, when to intervene, whom to avoid in the lifts and, now, where to work each day.

To take one example, when your inbox brims with new emails at the start of a new day, there is absolutely no way to read them all carefully. Intuition is what helps you decide which ones to answer and which to delete or leave unopened. Emails that are part of existing threads: open. Messages from people directly above and below you: open. Reminders from the chief information officer that cyber-security really, really matters: delete.

Instinct is also at work on those occasions when people have completely zoned out. They might be working on something else during a Zoom call, or playing chess on their phones, or simply admiring the ceiling pattern. Suddenly they are aware of a silence, and realise that they have been asked something or are expected to make a contribution. This is the office equivalent of coming face to face with a lion. Those who are fit to survive will say something plausible like “I’d like to understand how we are measuring success,” prompting murmurs of agreement from everyone else who hasn’t been paying attention but senses this might be a good answer.

Fast thinking is not just about self-preservation. It can help the entire organisation. The value of many managerial decisions lies in the simple fact that they have been made at all. Yet as data gushes from every pore of

the modern organisation, the temptation to ask for one more bit of analysis has become much harder to resist. A well-established psychological phenomenon known as “verbal overshadowing” captures the danger of overthinking things: people are more likely to misidentify someone in a line-up if they have spent time writing a description of their faces. Managers often suffer from analytical overshadowing, mulling a simple problem until it turns into a complex one.

When to use intuition in the workplace rests on its own form of pattern recognition. Does the decision-maker have real expertise in this area? Is this a domain in which emotion matters more than reasoning? Above all, is it worth delaying the decision? Slow thinking is needed to get the big calls right. But fast thinking is the way to stop deliberation turning to dither. ■



巴托比

管理者何时该信自己的直觉？

深思熟虑并不总是可取

经过数百万年的进化，人类已经被打磨得无需多想能对某些情境做出反应。如果你的祖先发觉灌木丛中有动静，他们会先撒腿跑，过后才咕哝着问发生了啥。与此同时，分析和计划的能力是人区别于其他动物的特征之一。什么时候该相信直觉，什么时候该检验假设——用心理学家丹尼尔·卡尼曼（Daniel Kahneman）的话说就是该快思还是慢想——这个问题在办公室里和在大草原上一样重要。

深思熟虑是一个工作场所管理得当的标志。战略改革和预算讨论是建立在一轮又一轮会议、备忘录、方案和报告的基础之上。流程的设计初衷越来越倾向于压制人的本能反应。从盲选求职者演变到使用“红队”研判法给公司计划挑刺，缜密打败了条件反射。

然而本能也有用武之地。有些决策与情绪反应关联更大，本质上就不那么容易分析。比方说，一轮营销活动是否展现出了公司的精髓？这个人会不会和团队中的其他人合作无间？在棘手的客户服务情形中，直觉往往是比脚本更好的行为指南。

源自肺腑的直觉也可以被改进（可以称之为“益生菌管理”）。大量研究表明，随着经验的积累，直觉会变得更加准确。在2012年进行的一项著名实验中，志愿者被要求评估一些名牌手袋是真是假。研究人员请一些人凭直觉做判断，另一些人斟酌着做选择。直觉对那些拥有至少三个名牌包的人更有效，甚至比分析还管用。你越驾轻就熟，直觉就越准。

然而，拥抱快思的真正原因是，呃，它够快。靠本能做决策往往是度过一天的唯一方法。康奈尔大学的研究人员曾经估计，人们每天仅在食物这一项就要做200多个决定。职场不过是一连串的选择，大决定寥寥，小决定很多：把什么列为优先项，什么时候介入，在电梯里避开谁，如今还得琢

磨每天在哪里工作。

举个例子，当新的一天开始，你的收件箱里塞满了新邮件，你绝对没办法把它们全都仔细读一遍。直觉会帮助你决定哪些需要回复，哪些可以删除或不打开。属于现有线程的电子邮件：打开。直属上司和直接下属的消息：打开。首席信息官提醒网络安全真的真的很重要的消息：删掉。

当人们完全走神时，本能也会起作用。在参加Zoom会议时，他们可能正在做别的事，或者在手机上下棋，或者只是在欣赏天花板的图案。突然间，他们感觉到一片寂静，然后意识到有人问了自己什么问题，或者要求自己贡献一些见解。这相当于职场版的直面一头狮子。那些适合生存的人会说一些听起来很有道理的话，比如“我想知道我们是如何衡量成功的”，其他人尽管一直在开小差，但也能感觉到这可能是一个好的回答，纷纷小声附和。

快思不仅仅是为了自保。它可以帮到整个组织。许多管理决策的价值就在于一个简单的事实：它们总归是做出来了。然而，随着现代组织的每一个毛孔都在渗出大量数据，要抗拒再多做一点点分析的诱惑难度大增。有一种已被普遍确认的心理现象叫“语言遮蔽”，精准体现了过度思考的危险：如果人们在指认一群人中的某人之前先写下自己对这些人面孔的描述，那他们就更有可能会认错人。主管们经常会落入“分析遮蔽”的陷阱，对一个问题绞尽脑汁，直到它变成一个复杂的问题。

何时该在工作场合中运用直觉有一套它自己的模式识别法。决策者在这方面是否具备真正的专业知识？在这个领域中情感是不是比理性更重要？最重要的是，推迟做决定是否值得？要做出正确的重大决策需要慢想。但快思是阻止再三斟酌滑向犹豫不决的妙方。■



More cash, stat!

After a covid-fuelled adrenaline rush, biotech is crashing

Many firms will not survive

THREE YEARS ago no one had heard of BioNTech. Today the German biotechnology firm enjoys global renown, as well as annual revenues of \$19bn. The company owes both the lustre and the lucre chiefly to the successful mRNA covid-19 vaccine which it developed in partnership with Pfizer, an American drug giant. Yet even the effective jab has not immunised it from a downturn afflicting the biotech industry. On August 8th BioNTech reported that sales fell by 40% in the second quarter, year on year, as fewer people are left unjabbed and unboosted. Its share price tumbled by nearly 9%.

The biotech industry is particularly vulnerable to the syndrome of slowing economic growth, higher inflation and rising interest rates. As with other tech startups, rate rises make promised profits, most of which lie far in the future, look less hale today. Unlike software firms, biotech companies need constant injections of capital to develop their drugs, which takes lots of time and money.

Until recently that money was easy to tap. Biotech startups raised \$34bn globally last year, twice the figure in 2020. In the first six months of 2021, 61 such firms launched initial public offerings (IPOs) in America alone. Since then cash has grown scarcer. The first half of 2022 saw just 14 American IPOs. None of the 24 startups that Silicon Valley Bank, a lender to techie companies, expected to go public this year has made the jump. Funding for private biotech businesses is down, too. Banks are reluctant to lend to early-stage firms, whose fate is tied to treatments that might never materialise.

Many companies are shedding staff. Earlier this month Atara and MacroGenics, two medium-sized public firms, announced big layoffs. An index of biotech companies listed on New York's Nasdaq exchange has fallen by a quarter since its peak a year ago, further than the sliding NASDAQ index overall (see chart). Valuations of unlisted companies are dropping faster than ever, says Lain Anderson of L.E.K. Consulting. Not all will pull through.

As non-specialist investors swept up in the pandemic biotech boom retreat, more discerning ones are sharpening their pencils. Some companies suddenly look cheap, especially those with proven treatments or drugs in late-stage trials. Venture-capital firms have raised over \$100bn to invest in life-sciences businesses in the past three years, notes Tim Haines of Abingworth, a biotech-focused asset manager. They still have plenty of unspent "dry powder" to deploy.

Big pharma in particular may be eyeing up biotech startups with promising drug pipelines. The giants will see some \$300bn-worth of patents expire by 2030, says Mr Haines. Pfizer has been particularly acquisitive—and, thanks to the \$37bn it earned last year from sales of its covid vaccines and treatments, particularly flush. On August 8th it agreed to pay \$5.4bn for Global Blood Therapeutics, a maker of a treatment against sickle-cell disease, bringing its total takeovers to more than \$25bn in the past 12 months.

As for Pfizer's covid-vaccine partner, BioNTech, it is still worth five times what it was before the pandemic, despite a 50% crash in its market capitalisation since the peak a year ago. Don't bring out the defibrillator just yet. ■



加钱，快！

在新冠引发一轮亢奋之后，生物科技业正在倒下

许多公司会活不下去

三年前，没人听说过BioNTech。如今，这家德国生物技术公司享誉全球，年收入高达190亿美元。公司的光芒和利润主要源于它与美国制药巨头辉瑞合作成功开发的mRNA新冠疫苗。不过即便是这么有效的疫苗也无法让它对生物技术行业正在经历的一轮低迷免疫。8月8日，BioNTech报告称其第二季度销售额同比下降了40%，因为没有接种疫苗和加强针的人越来越少。公司股价暴跌近9%。

生物技术行业特别容易受到经济增长放缓、通胀加剧和利率上升的综合症的影响。与其他科技创业公司一样，加息让它所承诺的利润（其中大部分要到遥远的未来才能实现）在如今看来不那么稳当了。和软件公司不同，生物技术公司需要不断注入资金研发药物，这种研发耗费大量时间和金钱。

直到最近，钱还很容易拿到。去年，生物技术创业公司在全球融资340亿美元，是2020年的两倍。在2021年前半年，仅在美国就有61家这类公司启动了IPO。但之后现金越来越稀缺。2022年上半年美国只有14次此类IPO。为科技公司提供贷款的硅谷银行（Silicon Valley Bank）曾预计今年有24家创业公司上市，但至目前还无一实现。给私营生物技术企业的融资也在减少。银行不愿向处于发展早期的公司提供贷款，因为它们的命运和那些可能永远不会问世的疗法绑在一起。

许多公司都在裁员。本月稍早时，两家中型上市公司Atara和MacroGenics宣布大规模裁员。在纽约纳斯达克交易所上市的生物技术公司的指数比一年前的峰值下跌了四分之一，超过了纳斯达克指数的整体跌幅（见图表）。L.E.K.咨询公司（L.E.K. Consulting）的莱恩·安德森（Lain Anderson）表示，未上市公司估值的下降速度之快前所未见。不是所有公司都能挺过去。

此前非专业投资者跟风投身由疫情引发的生物技术热潮，如今纷纷撤退。而眼光更犀利的投资者开始准备做划算的交易。一些公司突然看起来便宜了，尤其是那些疗法已经过验证或是药物研发处于后期试验阶段的公司。专注生物技术领域的资产管理公司Abingworth的蒂姆·海恩斯（Tim Haines）指出，在过去的三年里，风投公司筹集了超过1000亿美元注资生命科学行业。它们还有大把还没花出去的“干火药”可部署。

大型制药公司尤其可能会盯上那些拥有潜力候选药物的生物科技创业公司。海恩斯表示，到2030年，这些巨头会有约3000亿美元的专利到期。辉瑞在收购行动上特别积极，加上去年它从新冠疫苗和药物销售中赚取370亿美元，此时手头也特别宽裕。8月8日，它同意以54亿美元收购镰状细胞病治疗药物制造商Global Blood Therapeutics，令它在过去12个月的收购总花费超过了250亿美元。

至于辉瑞的新冠疫苗合作伙伴BioNTech，尽管其市值较一年前的峰值暴跌了50%，但仍是疫情前的五倍。还不用着急拿除颤器。 ■



Of industrial hubs and spicy crayfish

Xi Jinping's economic revolution aims to spread growth

An inland city, Changsha, highlights potential limits

TO GET A cup of milk tea from Chayan Yuese in the central Chinese city of Changsha, you may have to queue for an hour in the sweltering heat. The local company, known in English as “Sexy Tea”, has become a national sensation. Patrons insist that its method of steeping tea leaves and its ratio of water to milk produce a mellow brew that helps wash down fiery, pepper-laden local dishes.

It is part of what has made Changsha a wanghong hotspot, or a place where young people come to shoot videos for social media. Street vendors serving up spicy crayfish have become internet celebrities. Crowds throng the city's central shopping districts and eateries into the early hours of the morning, despite worries about covid-19. The local television station has become something akin to the Netflix of China. Chinese social media teems with photographs of young women, dressed in swanky outfits, posing in front of the city's 32-metre-high granite bust of Mao Zedong, the country's revolutionary leader who came from a nearby town.

China's recent development has concentrated wealth in eastern cities. Now President Xi Jinping wants to spread it inland to places like Changsha, and wants the process to be driven by innovation in emerging technologies such as artificial intelligence (AI), cloud computing and smart manufacturing—“industrialisation 4.0”, in his words. Central-government directives often seem far removed from real business activity. They are filled with lofty slogans and long-winded references to the importance of “Xi Jinping Thought”. Changsha offers a snapshot of how Mr Xi's revolution is actually playing out.

The city is one of 15 urban centres that is trying to make the leap into the country's elite. Together they are known as "new first-tier" cities, and already account for about a fifth of China's GDP. In Changsha, the local government is happy to have a wanhong economy: planners want to make the city a centre for culture and tourism that brings in 500bn yuan (\$74bn) in revenues a year, up from less than 200bn in 2021. They hope fashionable tea shops will also help with a much bigger challenge, and the main focus of their growth strategy: upgrading the city's industrial base. That will mean attracting a horde of new companies and talented people to a region hundreds of kilometres from wealthy coastal areas.

Changsha's strong but old-fashioned industrial base makes it typical of the new first tier: industry drove rapid growth in the early 2000s, but in the years since Changsha's performance has converged with the Chinese average (see chart). The city is home to China's two largest construction-machinery firms, Sany and Zoomlion. Another firm, BSB, is one of the country's biggest specialists in prefabricated construction. In a city just south of Changsha is one of the main manufacturing hubs of CRRC, China's state-owned rail outfit. These distinct specialties mean it should not have to compete head-on with neighbouring cities such as Chengdu, which has a big aircraft-manufacturing base, says Wang Tao of UBS, a bank, and a native of Changsha.

The first challenge planners face is upgrading the city's existing industry through digitisation and automation. The government has handed out large subsidies to encourage internet-technology companies to cluster around existing machinery, building and transport firms. Thousands of automation-related firms have been set up as a result. Officials are monitoring what happens next. One recent reform in industrial parks measures the amount of tax companies pay per mu (0.06 hectares) of land they occupy, and will eventually push out low payers.

Industrial upgrades often involve integrating brand-new systems—5G internet or AI-powered logistics—into legacy firms in order to help boost efficiency, note analysts at Jefferies, an investment bank. Baosight, a state-owned industrial-digitisation giant, has helped do this at many steel plants. These sorts of changes can take years and require large, experienced technology providers. But most of the companies working in Changsha are small. The city is not home to any large tech firms, which are mainly based in China's eastern cities. Even some neighbouring industrial hubs such as Chongqing and Chengdu score better on this front. This ultimately means the pace of industrial digitisation will be slower in Changsha, says Xu Dihong, the founder of Cadstar, a local industrial-software company.

The second challenge is to hasten a boom in new tech companies. Like several neighbouring cities, Changsha is hurrying to build AI and smart-manufacturing parks; last year the Ministry of Science and Technology announced that it would build a national AI innovation zone in the city. Some 5,180 firms claiming to offer AI-related services were set up in Changsha in the first seven months of 2022, up from about 3,000 in all of 2021, according to Qichacha, a corporate-intelligence firm. The trend has been mirrored across inland Chinese cities. Whether this reflects genuine tech entrepreneurialism is doubtful; experts believe many of the new AI firms do little in the way of real innovation.

A burgeoning tech hub also needs a steady supply of talent. In April the local government announced a list of 45 measures aimed at coaxing young professionals to the city, including grants of up to 100m yuan for top scientists and tech organisations. The cheapness of the city's wanghong lifestyle is another draw. Changsha has some of the lowest house prices of any large city in the country, making it especially attractive to young entrepreneurs. "A family can get twice the space in a flat here compared with a coastal city," says Mr Xu. The milk tea and late-night dining on crayfish do not hurt, either.

Yet they may not be enough. Wang Peng of Huijiang Automation Technology, a tech firm that set up an office in Changsha last year, says that despite the generous incentives it is still hard to hire the right people. Even established tech hubs such as Suzhou and Shenzhen face shortages of talented staff. The city also has few international links. Its location deep in China's interior has made it difficult to bring in the highest level of talent, especially Chinese people returning from university or work abroad, says a professor at a local university. It is a problem that could prevent many of the new first-tier cities making the leap to the very top. ■



是工业中心，也有香辣小龙虾

习近平的经济革命旨在拓展增长

内陆城市长沙凸显了潜在的局限

在中国中部城市长沙，要想买到一杯茶颜悦色的奶茶，你可能要在酷热的天气里排上一个小时的队。这家英文名为“SexyTea”的本地企业已经火遍全国。经常光顾它的人们坚信，它的泡茶方法以及茶和奶的配比能做出一杯醇厚的奶茶，为满是辣椒的湖南菜解辣。

长沙之所以能成为一个网红城市，吸引到许多年轻人前来拍摄社交媒体视频，茶颜悦色是原因之一。卖香辣小龙虾的大排档也在网上走红。尽管人们仍然担心疫情，但长沙的中心购物区和食肆直到凌晨都人潮涌动。当地的电视台已经堪比中国的奈飞。在中国的社交媒体上，常常可以看到穿戴时髦的年轻女子在该市一座高32米的毛泽东花岗岩半身像前摆姿势拍照，这位中国革命领袖就来自附近的小镇。

在中国近几十年的发展中，财富在东部城市聚集。现在，国家主席习近平想把财富扩展到像长沙这样的内陆地区，并且希望这一进程由人工智能（AI）、云计算和智能制造等新兴技术领域里的创新驱动——用他的话来说就是“工业4.0”。中央政府的指令似乎常常和真正的商业活动相去甚远。指令里充满了崇高口号和对“习近平思想”的重要性的长篇大论。长沙提供了一幅快照，让人们看到习这一革命的实际进展。

长沙是尝试跻身中国一线的15座城市之一。它们一起被称为“新一线”城市，已经占到中国GDP的五分之一左右。在长沙，当地政府乐见网红经济的起飞：规划者希望将这座城市打造成一个文化和旅游中心，每年带来5000亿元创收，而在2021年这部分还不到2000亿元。他们希望时尚的奶茶店还能帮助该市应对更大的挑战，也就是他们经济增长战略的主要焦点：升级该市的工业基础。这意味着要把大量新公司和人才从数百公里外的富裕沿海地区吸引过来。

长沙强大但老式的工业基础让它成为新一线城市的典型代表：工业在本世纪初推动了快速增长，但之后长沙的表现就渐渐趋近中国的平均水平（见图表）。长沙拥有中国最大的两家工程机械公司三一重工和中联重科。另一家公司远大科技集团是中国最大的预制建筑专家之一。中国国有轨道设备公司中国中车的一个主要制造中心恰在长沙南边的一个城市。这些特色专业领域意味着它不必和周边城市正面竞争，比如像成都这样拥有大型飞机制造基地的城市，在瑞银任职、长沙出生的汪涛表示。

规划者面临的第一个挑战是通过数字化和自动化升级该市现有的工业。政府提供了大量补贴，鼓励互联网技术公司聚集在现有的机械、建筑和运输企业的周围。这催生了数千家自动化相关企业。官员们正在密切关注接下来会发生什么。最近在工业园区推行的一项改革根据企业用地和缴税来衡量“亩均效益”，最终将淘汰纳税低的企业。

投资银行杰富瑞的分析师指出，产业升级通常都涉及将全新的系统——5G网络或人工智能驱动的物流——整合到传统公司中，帮助它们提高效率。国有工业数字化巨头宝信已经在帮助许多钢铁厂做这件事。这类变化可能耗时数年，需要经验丰富的大型技术供应商。但在长沙运营的公司大多规模较小。该市没有一家大型科技公司——这类企业的总部主要位于中国东部城市。即使是重庆和成都等邻近的工业中心在这方面的条件也更好些。这最终意味着长沙工业数字化的步伐会更慢，当地工业软件公司凯士达的创始人许弟洪说。

第二个挑战是加速新创科技公司的发展繁荣。和邻近的几个城市一样，长沙正在加紧建设人工智能和智能制造园区；去年科技部宣布将在该市建立一个国家人工智能创新区。企业情报公司企查查的数据显示，2022年前7个月，在长沙成立了约5180家声称提供人工智能相关服务的公司，而2021年全年约为3000家。这一趋势在中国内陆城市均有出现。这是不是真实的科技创业精神的体现还不好说，专家认为许多新出现的人工智能公司并没有多少真正的创新。

一个新兴科技中心还需要稳定的人才供应。4月，当地政府公布了45条政

策，目标是吸引年轻的专业人士到长沙，其中包括向顶尖科学家和技术机构提供最高1亿元的资助。长沙便宜的网红生活方式是另一个吸引人的点。长沙的房价在全国大城市中居最低之列，这对年轻创业者特别有吸引力。“一家人在这里买个房子能有沿海城市的两倍大。”许弟洪说。有奶茶和小龙虾宵夜也挺不错。

不过这些可能还不够。去年在长沙设立了办事处的科技公司汇匠自动化科技的王鹏表示，尽管有慷慨的激励政策，依然难以招到合适的人。即使是苏州和深圳等成熟的技术中心也有人才短缺的问题。长沙的国际联系也很少。当地一所大学的教授说，它深处中国内地，很难引进最高水平的人才，尤其是从国外学成或工作归来的人士。这个问题可能会阻挡许多新一线城市跃居真正的一线。 ■



Schumpeter

For business, water scarcity is where climate change hits home

It brings material risks, regulatory overreach and reputational damage

ONE OF YOUR columnist's favourite ways of passing a hot afternoon in Monterrey, three hours south of Mexico's border with Texas, is with a cold bottle of locally brewed Bohemia beer alongside a plate of cabrito (roast kid). For a business writer, it is a justifiable use of the expense account. Beers like Bohemia helped make Monterrey the industrial hub that it is. The Cuauhtémoc brewery, now owned by Heineken, a global giant, was started in 1890 by members of the Garza and Sada families, who went on to become Mexico's biggest industrialists. Lacking suppliers in the arid north, they made their own bottles, caps and packaging, giving rise to conglomerates that fuelled the country's modernisation. Today Mexico is the largest exporter of beer in the world.

Monterrey is still awash with beer. But it is also stricken by drought. This has left millions of residents reliant on leaky public pipes desperately short of water, even as the industries that employ them guzzle the stuff, thanks to higher-quality private infrastructure. The brewers say they consume less than 1% of the local water, most of which is used by farmers who have no incentive to conserve it. That has not stopped President Andrés Manuel López Obrador, never one to waste an opportunity to bash the rich, from blaming the industrialists. He has told the beer firms to up sticks and move south, where rivers still run in torrents.

The industry is keeping its head down, treating this as populist rhetoric rather than a genuine demand to transplant breweries lock, stock and barrel to the other end of the country. Yet the imbroglio is illustrative, too. It shows how water shortages, combined with reputational damage and regulatory overreach, could affect many hydro-dependent industries, from

food production, mining and power generation to apparel and electronics. Colin Strong of the World Resources Institute (WRI), an NGO, says that though the private sector is trying to use water more efficiently, scarcity will be exacerbated by climate change, population growth and the greater water use that comes with growing prosperity. He quotes a pithy refrain common in environmental circles. “If climate change is the shark, water is its teeth.”

Heat and drought are leaving teeth marks everywhere. In Chile, the world’s biggest copper producer, the driest decade on record has forced mining firms such as Anglo American and Antofagasta to reduce output this year. In recent days companies such as Toyota, a carmaker, and Foxconn, which makes iPhones for Apple, halted production in south-western China after a drought caused hydropower shortages. On August 16th the American government took unprecedented steps to reduce water consumption in states in the Lower Colorado River Basin to safeguard reservoirs crucial for generating electricity. Norway, known as the battery of Europe for its abundant hydropower, says that water shortages may force it to curb supplies to its neighbours’ grids. In Germany, the Rhine has fallen so low that it has affected the ferrying of cars and chemicals north, and coal and gas south. Across unusually rain-free Europe, grain crops have frazzled in the heat. So have cotton fields in thirsty Texas.

The problem is not a lack of water per se. Climate change may make some places drier and others wetter. It is the uneven distribution of freshwater—of which fast-growing places like India are woefully short—that provide the conditions for a crisis. This is made worse by waste, pollution and the near-universal underpricing of water. Some governments, notably China’s, have created pharaonic projects to transport water to where it is needed. Others, such as Mr López Obrador’s, peddle the quixotic idea of moving demand to where the water is. The best outcome in the long term, on paper at least, is the simplest: that less of the stuff is used,

and more of what is used is treated better. It is something the private sector is just starting to grapple with.

Industries directly affected by water shortages have got a head start. Global mining firms are using desalination plants in Chile. Beer and soft-drinks companies, existentially reliant on clean water, have targets for improving efficiency (Heineken says it uses 2.5 litres of water to make a litre of beer in Mexico, about half the global industry average). In collaboration with the WRI, Cargill, an agro-industrial behemoth, recently extended the monitoring of water use from its own operations to the farmers who supply its crops. Fashion retailers, whose suppliers are often heavy users of water and dyes in dry areas, are considering similar moves, to avoid angry flare-ups by local residents who worry about being second in line to the taps.

This calls for careful stewardship. When Cape Town was in danger of running out of water in 2017, AB InBev, one of the world's largest brewers, helped municipal authorities reduce water loss from the network. Ingenuity also helps. In Singapore, NewBrew makes craft beer out of reclaimed sewage. Andre Fourie, head of sustainability at AB InBev, says that in the future many companies will have to treat and reuse water to overcome scarcity.

| *Last orders*

The looming shortages still do not get the attention they deserve. As a heavily subsidised raw material, water is so cheap that many CEOs overlook it. A report this year by Planet Tracker and CDP, two NGOs, said that about a third of listed banks do not assess water risks in their portfolios. For shareholders, it mostly comes far behind carbon emissions as an environmental, social and governance (ESG) concern. It is not a risk that can easily be squeezed into oversimplified ESG ratings. It is so dependent on local conditions that it requires myriad approaches.

In the words of Will Sarni, a consultant, water is an enigma. “It’s a personal thing. It’s a social issue. It’s got a spiritual dimension.” He hopes new technologies that use solar power to capture moisture from the air could bring creative destruction to the supply of water. Schumpeter, Bohemia in hand, would drink to that. ■



熊彼特

对企业而言，气候变化导致的缺水是致命一击

这带来了实质风险、监管过度和声誉受损

在距墨西哥与美国得克萨斯州交界处以南三小时车程的蒙特雷（Monterrey），笔者最爱的打发炎热午后的方式之一是用一瓶当地酿造的冰镇波西米亚（Bohemia）啤酒配一盘烤羊羔肉。作为一名商业撰稿人，这一餐可以顺理成章地计入公费报销。像波西米亚这样的啤酒品牌帮助蒙特雷成长为墨西哥的工业中心。库奥特莫克啤酒厂（Cuauhtémoc，如今属全球啤酒巨头喜力旗下）由墨西哥的加尔萨（Garza）和萨达（Sada）家族成员于1890年创办，他们后来成为墨西哥的顶级工业大亨。位处墨西哥北方的贫瘠之地，缺乏供应商的他们自己制造瓶子、瓶盖和包装，从而发展成企业集团，推动了墨西哥的现代化进程。今天，墨西哥是全球最大的啤酒出口国。

蒙特雷如今依然到处是啤酒。但它也被干旱袭扰，几百万依赖老旧渗漏的公共水管的居民极度缺水，而他们受雇的行业却凭借状况更好的私有水管大量用水。酿酒商称自己只消耗了不到1%的本地水资源，而大部分水被毫无节水动力的农民用掉了。但这不妨碍会抓住任何时机来抨击富人的墨西哥总统洛佩斯把问题归咎于工业家。他叫啤酒公司搬到河流量丰沛的南方去。

啤酒行业目前低调做人，只当它是民粹主义者的一种话术，而不是真要自己把全部家当都搬到国土的另一端去。但这种尴尬处境也很能说明问题。它显示了水资源短缺加上声誉损害和监管过度可能会影响许多依赖水的行业，包括食品生产、采矿、发电、服装和电子产品等。非政府组织世界资源研究所（World Resources Institute，以下简称WRI）的科林·斯特朗（Colin Strong）指出，尽管私营部门在努力提高用水效率，但气候变化、人口膨胀、经济繁荣导致的用水量增加都将使缺水问题进一步恶化。他引用环保界一句精辟的名言概括道：“如果气候变化是鲨鱼，水就是它的利齿。”

高温和干旱正到处留下齿痕。在世界最大产铜国智利，近十年来的干旱天气史无前例，迫使英美资源集团（Anglo American）和安托法加斯塔（Antofagasta）等矿业公司在今年减产。近日，中国西南部因干旱导致水电短缺，汽车制造商丰田和为苹果公司生产iPhone的富士康等厂商在当地的工厂被迫停产。8月16日，美国政府采取了前所未有的措施，减少科罗拉多河下游各州的供水量，以保障对发电至关重要的水库水位。因水电资源丰富而被誉为欧洲蓄电池的挪威表示，缺水可能会迫使它减少向邻国电网供电。在德国，莱茵河水位过低，已经影响到汽车和化学品的北运，以及煤炭和天然气的南运。欧洲各地异常干旱，粮食作物在高温下枯萎，得克萨斯州的棉田同样在干旱中奄奄一息。

问题不在缺水本身。气候变化可能令一些地方变得更干旱而另一些地方更潮湿。正是这种淡水分布不均（印度这类快速增长的地方严重缺乏淡水）为危机的发生提供了条件。浪费、污染，加上水价几乎普遍过低，让问题更为严重。一些政府，特别是中国的，已经实施了法老王式的项目来向有需要的地区调水。其他政府，如洛佩斯的，则在倡导一种唐吉珂德式的理念，要把需求转移到水源充沛之地。长远来看，至少在理论上，最好的结果是最简单的：用水量减少，更多废水被更好地处理回收。这是私营部门正开始着手解决的。

那些直接受缺水影响的行业先行一步。跨国矿业公司正在智利启用海水淡化工厂。极度依赖洁净水源的啤酒和软饮料公司会设定目标提升用水效率（喜力公司称自己在墨西哥制造一升啤酒耗用2.5升水，约为全球行业平均水平的一半）。农业巨头嘉吉（Cargill）与WRI合作，最近把监测用水的范围从自身运营扩展至向它提供粮食的农民。时装零售商的供应商往往是干旱地区的用水和用染料大户，它们正在考虑采取类似措施，以避免和担心水源被抢占的当地居民产生矛盾。

这需要严谨的组织管理。2017年开普敦面临缺水危机之际，全球最大的啤酒商之一百威英博（AB InBev）帮助市政当局减少供水管网的漏损。发挥创意也有帮助。在新加坡，NewBrew用回收污水制造精酿啤酒。百威英博的可持续发展负责人安德烈·傅里（Andre Fourie）表示，在未来，许

多公司将不得不通过处理并再利用废水来克服水资源短缺的问题。

| 还有谁要酒的快下单

缺水问题迫在眉睫，但仍得不到应有的重视。作为受政府大力补贴的一种原材料，水的价格之低让许多CEO没把它当回事。行星追踪（Planet Tracker）和CDP全球环境信息研究中心这两个非政府组织今年发表的一份报告指出，大约三分之一的上市银行没有评估其投资组合中的水资源风险。在大多数股东眼中，同属环境、社会和治理（ESG）问题的水资源风险远排在碳排放之后。这项风险并不能被随意塞进过度简化的ESG评级中，而是高度取决于本地条件，需要各种各样的应对措施。

用咨询顾问威尔·萨尼（Will Sarni）的话说，水是一个谜。“它是个人事务。它是社会议题。它具有灵性维度。”他希望使用太阳能收集空气中的水分的新技术能为水供应带来创造性破坏。笔者要举起手中的波西米亚啤酒为之喝彩。■



Cell-side analysis

Could the EV boom run out of juice before it really gets going?

Quite possibly, for want of batteries

ELECTRIC VEHICLES (EVs) appear unstoppable. Carmakers are outpledging themselves in terms of production goals. Industry analysts are struggling to keep up. Battery-powered cars may zoom from 10% of global vehicle sales in 2021 to 40% by 2030, according to BloombergNEF. Depending on whom you ask, that could translate to between 25m and 40m EVs a year. They, and the tens of millions manufactured between now and then, will need plenty of batteries. Bernstein reckons that demand from EVs will grow six-fold by 2030 (see chart 1), to 2,700 gigawatt-hours (GWh). Rystad puts it at 4,000GWh.

Such forecasts explain the frenzied activity up and down the battery value chain. The ferment stretches from the salt flats of Chile's Atacama desert, where lithium is mined, to the plains of Hungary, where on August 12th CATL of China, the world's biggest battery-maker, announced a €7.3bn (\$7.5bn) investment to build its second European "gigafactory".

It is, however, looking increasingly as though the activity is not quite frenzied enough, especially for the Western car companies that are desperate to reduce their dependence on China's world-leading battery industry amid rising geopolitical tensions. Prices of battery metals have spiked (see chart 2) and are expected to push battery costs up in 2022 for the first time in more than a decade.

In June BloombergNEF cast doubt on its earlier prediction that the cost of buying and running an EV would be as low as for a fossil-fuel car by 2024. More distant targets, such as the EU's coming ban on new sales of carbon-burning cars by 2035, may not be met. Could the EV boom run out of juice

before it gets going in earnest?

On paper, there ought to be plenty of batteries to go round. Benchmark Minerals, a consultancy, has analysed manufacturers' declared plans and found that, if they materialise, 282 new gigafactories should come online worldwide by 2031. That would take total global capacity to 5,800GWh. It is also a big "if". Bernstein calculates that current and promised future supply from the six established battery-makers—BYD and CATL of China; LG, Samsung and SK Innovation of South Korea; and Panasonic of Japan—adds up to 1,360GWh by the end of the decade. The balance would have to come from newcomers, and being a newcomer in a capital-intensive industry is never easy.

The optimistic overall capacity projections conceal other problems. Matteo Fini of S&P Global Mobility, a consultancy, notes that gigafactories take three years to build but require longer—possibly a few extra years—to manufacture at full capacity. As such, actual output by 2030 may fall short. Moreover, manufacturers' unique technologies and specifications mean that cells from one factory are usually not interchangeable with those from another, which could create further bottlenecks.

Most troubling for Western carmakers is China's dominance of battery-making. The country houses close to 80% of the world's current cell-manufacturing capacity. Benchmark Minerals forecasts that China's share will decline in the next decade or so, but only a bit—to just under 70%. By then America would be home to just 12% of global capacity, with Europe accounting for most of the rest.

Americans' slower uptake of EVs may ease the crunch for carmakers there. Deloitte, a consultancy, expects America to account for fewer than 5m vehicles of the 31m EVs sold in 2030, compared with 15m in China and 8m in Europe. Detroit's auto giants already have joint ventures with the big

South Korean battery-makers to build domestic gigafactories. In July Ford and SK Innovation finalised a deal to build one in Tennessee and two in Kentucky, with the carmaker chipping in \$6.6bn and SK Innovation \$5.5bn. The same month it struck a deal to import CATL batteries. General Motors and LG Energy are together putting more than \$7bn into three battery factories in Michigan, Ohio and Tennessee.

It is Europe's carmakers that seem most exposed. Volkswagen plans to construct six gigafactories of its own by 2030. Some, such as BMW, are teaming up with the South Koreans. Others, including Mercedes-Benz, are investing in European battery-making through a joint-venture called ACC. A number of European startups, such as Northvolt of Sweden, which is backed by Volkswagen and Volvo, are also busily building capacity. Yet the continent's car industry looks likely to remain quite reliant on Chinese manufacturers. Some of those batteries will be made locally: CATL's first investment in Europe, a battery factory in Germany, is set to begin operations at the end of the year. Some packs or their components may, however, still need to be imported from China.

That is not a comfortable position to be in for European carmakers. It may become even less so if the EU enacts levies based on total lifecycle emissions from vehicles, including EVs. Northvolt's chief executive, Peter Carlsson, reckons that proposed EU tariffs on carbon-intensive imports could add 5-8% to the cost of a Chinese battery made using dirty coal power. That could be roughly equivalent to an extra \$500, give or take, per pack. Such rules would boost his firm's prospects, since it runs on clean Nordic hydroelectricity. It would also severely limit European carmakers' ability to source batteries from abroad.

These manufacturing bottlenecks, serious though they are, look manageable next to those at the mining end of the battery value chain. Take nickel. Thanks to a production jump in Indonesia, which accounts for 37%

of global output, the market seems well supplied. However, Indonesian nickel is not the high-grade sort usable in batteries. It can be made into battery-compatible stuff, but that means smelting it twice, which emits three times more carbon than refining higher-grade ores from places like Canada, New Caledonia or Russia. Those additional emissions defeat the purpose of making EVs, notes Socrates Economou of Trafigura, a commodities trader. Carmakers, particularly European ones, may shun the stuff.

Cobalt has become less of a pinch point. A price spike in 2018 prompted battery-makers to develop battery chemistries that use much less of it. Planned mine expansions in the Democratic Republic of Congo (DRC), home to the world's richest cobalt deposits, and Indonesia should also tide battery-makers over until 2027. After that things get trickier. Getting more of the metal may require manufacturers to embrace the DRC's artisanal mining, the formalisation of which has yet to bear fruit. Until it does, many Western carmakers say they would not touch the sector—where adults and many children toil in harsh conditions—with a barge-pole.

Most uncertainty concerns lithium. A shortage is forcing some manufacturers to cut production. For now consumer-electronics firms are bearing the brunt. But their gadgets' smaller batteries represent a fraction of demand. EV-makers, whose battery packs use a lot more, could be next.

By 2026 the lithium market is projected to tip back into surplus, thanks to planned new projects. However, most of these are in China and rely on lower-grade deposits which are much costlier to process than those of Australia's hard-rock mines or Latin America's brine ponds. Mr Economou estimates that a price of \$35,000 per tonne of the battery-usable form of lithium carbonate is required to make such projects worthwhile—lower than today's lofty levels, but three times those a year ago.

High-grade lithium due to come from elsewhere should not be taken for granted, either. Chile's new draft constitution, which will be put to a referendum in September, proposes nationalising all natural resources. Changes to the tax regime in Australia, which already has some of the highest mining levies in the world, could deter fresh investments in "green"-metal production. In late July the boss of Albemarle, the largest publicly traded lithium producer, warned that, despite efforts to unlock more supply, carmakers faced a fierce battle for the metal until 2030.

Because building mines can take anywhere between five and 25 years, there is little time left to get new ones up and running this decade. Big miners are reluctant to enter the business. Markets for green metals remain too small to be worth the hassle for the mining "majors", says the development boss at one such firm. Despite their reputation for doing business in shady places, most lack the stomach to take a gamble on countries as tricky as the DRC, where it is hard to enforce contracts. Smaller miners that usually get risky projects off the ground cannot raise capital on listed markets, where investors are queasy about the mining industry, which is considered risky and, ironically, environmentally unfriendly.

The resulting dearth of capital is attracting private-equity firms (often founded by former mining executives) and manufacturers with a taste for vertical integration. Battery-makers like LG and CATL have backed mining projects. Since the start of 2021 car firms have made around 20 investments in battery-grade nickel, and five others in lithium and cobalt. Most of these projects involved Western companies. In March, for example, Volkswagen announced a joint venture with two Chinese miners to secure nickel and cobalt for its EV factories in China. In July General Motors said it would pay Livent, a lithium producer, \$200m upfront to secure lumps of the white metal. The American EV champion, Tesla, is signing deals left and right.

Mick Davis, a coal-mining veteran now at Vision Blue Resources, a firm that

invests in smaller miners, doubts all this dealmaking will be enough to plug the funding gap. Recycling, which makes up a quarter of supply in many mature metals markets, is not expected to help much before 2030. Tweaks to battery designs may moderate demand for the scarcest metals somewhat, but at the risk of lower battery performance. Lithium in particular will remain hard to substitute. Technologies that do away with it entirely, such as sodium-based cathodes, are a long way off.

Even if the West's EV industry somehow managed to secure enough metals and battery-making capacity, it would still face a giant problem in the middle of the supply chain, refining, where China enjoys near-monopolies (see chart 3). Chinese companies refine nearly 70% of the world's lithium, 84% of its nickel and 85% of its cobalt. Trafigura forecasts that the shares for the last two of these will remain above 75% for at least the next five years. And as with battery manufacturers, Chinese refiners gobble up dirty coal-generated electricity. On top of that, according to Trafigura, both European and North American firms are also expected to rely on foreign suppliers, often Chinese ones, for at least half the capacity to convert refined ores into the materials that go into batteries.

Western governments grasp the urgent need to diversify their suppliers. Last year Joe Biden, America's president, unveiled a blueprint for a domestic battery supply chain. His huge infrastructure law, passed in 2021, set aside \$3bn for battery-making in America. The Inflation Reduction Act, which he signed into law on August 16th, also includes sweeteners for the industry, so long as the ores, refined materials and components come from America or allied countries. The EU, which created a battery alliance in 2017 to co-ordinate public and private efforts, says €127bn was invested last year across the supply chain, with an additional €382bn expected by 2030. Most of this is likely to land downstream, helping the West become self-sufficient in the production of finished cells by 2027.

That is something. And newfound deposits, better mining technology, cleverer battery chemistry and sacrifices on performance may yet combine to bring the market into balance. More probably, as Jean-François Lambert, a commodities consultant, puts it, the EV industry is “going to be living a big lie for quite some time”. ■



电池供应分析

电动汽车热未上路就没电？

很有可能，因为电池不够【深度】

电动汽车看似势不可挡。汽车制造商正在超越自己的生产目标。行业分析师正手忙脚乱地试着跟上趋势。据彭博新能源财经（BloombergNEF）报道，到2030年，电池驱动的汽车在全球汽车销量中的占比可能会从2021年的10%增长到40%。这可能相当于每年销售2500万至4000万辆电动汽车，不同人预估的数字各有不同。再加上从现在到2030年将要生产出来的数以千万计的电动汽车，这会产生巨大的电池需求。盛博估计，到2030年，电动汽车的电池需求将增长五倍（见图表1），达到2700吉瓦时（GWh）。睿咨得（Rystad）的估计是4000吉瓦时。

这样的预测解释了整个电池价值链上下游的那些狂热动作。热潮从开采锂矿的智利阿塔卡马沙漠（Atacama）的盐滩一直蔓延至匈牙利的平原。8月12日，全球最大的电池制造商宁德时代宣布将投资73亿欧元（75亿美元）在匈牙利建造它在欧洲的第二个“超级工厂”。

然而，这些行动似乎日益显得还不够疯狂，尤其是对西方汽车公司而言，因为它们迫切希望在地缘政治紧张局势加剧之时减少对中国领先全球的电池产业的依赖。电池金属的价格已经飙升（见图表2），预计在2022年将推动电池成本出现10多年来首次上涨。

6月，彭博新能源财经对自己早先的预测表示了怀疑，它曾预测到2024年购买和驾驶电动汽车的成本将和化石燃料汽车一样低。更遥远一些的目标——比如欧盟将在2035年前禁售新燃油车——可能无法实现。电动汽车热潮会否还没有真正上路就已电量不足？

理论上电池应该够用。咨询公司Benchmark Minerals分析了制造商宣布的生产计划后发现，如果这些计划均能实现，到2031年全球将有282家新的超级工厂投产。这将让全球总产能达到5800吉瓦时。这里边的不确定性也

很高。盛博计算了中国的比亚迪和宁德时代、韩国的LG、三星和SK Innovation以及日本的松下这六家老牌电池制造商当前的供应量和承诺的未来供应量，结果显示它们到2030年前总共会有1360吉瓦时的产能。两个数字之差必须由新来者补上，而要在资本密集型行业里做一个新来者绝非易事。

乐观的总体产能预测掩盖了其他问题。咨询公司S&P Global Mobility的马迪奥·费尼（Matteo Fini）指出，超级工厂需要三年时间才能建成，但需要更长的时间（可能还要再花几年）才能开足马力生产。因此，到2030年实际产出可能达不到预测水平。此外制造商的技术和规格都各不相同，意味着一家工厂生产的电池通常不能与另一家互换，可能会进一步造成瓶颈。

最让西方汽车制造商不安的是中国在电池制造领域的主导地位。中国当前拥有全球电池产能的近80%。Benchmark Minerals预测，中国的产能份额在今后十来年里会下降，但也只是下降一点点，至略低于70%。届时，美国也只会拥有全球产能的12%，其余产能大部分在欧洲。

美国人对电动汽车接受得较慢，可能会缓解该国汽车制造商在电池方面的压力。咨询公司德勤预计，2030年将售出3100万辆电动汽车，其中美国占500万辆不到，而中国和欧洲将分别占1500万辆和800万辆。底特律的汽车巨头已经与韩国大型电池制造商成立了合资企业，在美国国内建设超级工厂。7月，福特和SK Innovation敲定了一项协议，在田纳西州建一座超级工厂，在肯塔基州建两座，福特投资66亿美元，SK Innovation投资55亿美元。同月，福特达成了进口宁德时代电池的协议。通用汽车和LG新能源（LG Energy）将共同向密歇根州、俄亥俄州和田纳西州的三座电池工厂投入超过70亿美元。

欧洲的汽车制造商受到的影响似乎最大。大众计划到2030年建造六座自己的超级工厂。宝马等一些公司正在与韩国企业合作。包括梅赛德斯-奔驰在内的其他公司正在通过一家名为ACC的合资企业投资于欧洲的电池制造。大众和沃尔沃投资的瑞典Northvolt等一些欧洲创业公司也在忙于产能

建设。然而，欧洲大陆的汽车产业看起来仍然会相当依赖中国电池制造商。有一些电池将在当地生产，宁德时代在欧洲投资的第一座电池工厂位于德国，将于今年年底投产，但一些电池组或组件可能仍需从中国进口。

欧洲汽车制造商这样的处境不太有利。如果欧盟根据车辆（包括电动汽车）的生命周期总排放征税，情况可能会变得更糟。Northvolt的首席执行官彼得·卡尔森（Peter Carlsson）认为，欧盟提出要对碳密集型进口产品征收关税，可能会让用高污染煤电制造的中国电池的成本增加5%至8%。这可能大致相当于每组电池增加500美元。这些新规可能改善卡尔森的公司的前景，因为Northvolt用的是清洁的北欧水电。但这也严重限制欧洲汽车制造商从国外采购电池的能力。

这些制造瓶颈虽然很严重，但与电池价值链中采矿环节的瓶颈相比似乎还算可控。以镍矿为例，占全球镍产量37%的印度尼西亚产量大幅增长，所以市场似乎供应充足。然而，印尼镍不是适用于电池的高品位镍。它可以加工成可用于电池的材料，但这意味着要做两次精炼，排放的碳比精炼加拿大、新喀里多尼亚（New Caledonia）或俄罗斯等地的高品位矿石高三倍。大宗商品交易商托克（Trafigura）的苏格拉底·埃克诺穆（Socrates Economou）指出，这些额外的排放有违生产电动汽车的初衷。汽车制造商，尤其是欧洲的制造商，可能会避开使用这样的原料。

钴已不再是生产电池的主要夹点。2018年钴价飙升，促使电池制造商研究在电池成分中大大减少钴的用量。世界上钴矿资源最丰富的刚果民主共和国（刚果金）和印度尼西亚都计划扩建矿山，这应该能在2027年前满足电池制造商的需要。在那之后，情况就会变得更加棘手。要获得更多的钴可能需要制造商接受刚果金的人工采矿，而人工采矿的规范管理尚未取得成果。在那之前，许多西方汽车制造商表示，它们不会跟这种让成年人和许多儿童在恶劣条件下辛苦工作的行业沾上任何关系。

大多数不确定性都与锂有关。锂短缺正在迫使一些制造商减产。消费电子企业目前首当其冲。但它们生产的电子设备使用的电池较小，只占需求的一小部分。电动汽车制造商的电池组用锂量多得多，可能会在接下来面临

冲击。

考虑到已规划的新项目，预计到2026年锂市场将重新出现供应过剩。然而大部分项目都在中国，依赖低品位的锂矿，加工成本要比澳大利亚的硬岩矿或拉丁美洲的盐湖卤水高得多。埃克诺穆估计，可用于电池的碳酸锂价格要在每吨3.5万美元才能让这些项目盈利，这个价格低于目前的高昂水平，但仍是一年前价格的三倍。

也不能理所当然地认为其他地方就能顺利供应高品位锂。智利的新宪法草案将于9月进行全民公决，草案提议将所有自然资源国有化。澳大利亚的一些矿业税为全球最高之一，其税制变化可能会阻碍对“绿色”金属生产的新投资。7月下旬，最大上市锂生产商Albemarle的老板警告说，尽管各方在努力释放更多供应，但汽车制造商在2030年之前仍将面临激烈的锂争夺战。

由于建设矿山耗时5到25年不等，所以要在本十年里让新矿山建成投产已经时日无多。大矿商都不大愿意踏足这个业务。一家矿业公司的开发负责人表示，绿色金属市场仍然太小，不值得矿业“巨头”费功夫。尽管以善于在不诚实的地方做生意闻名，大多数公司都没有勇气在刚果金这样环境复杂、合同难以执行的国家下赌注。愿意启动高风险项目的小型矿业公司无法在公开市场上筹到资金，因为投资者对矿业没有信心，认为它风险太高，颇讽刺的是，还认为它对环境不友好。

由此导致的资本匮乏吸引了私募股权公司（通常由前矿业高管创立）和喜欢垂直整合的制造商。LG和宁德时代等电池制造商已经投资了采矿项目。自2021年初以来，汽车制造商已经投资了约20笔电池级镍项目，还有五笔锂和钴的项目。这些项目大多都有西方公司参与。例如，今年3月，大众宣布与两家中国矿业公司成立合资企业，为它位于中国的电动汽车工厂供应镍和钴。通用汽车在7月表示，将向锂生产商Livent预付2亿美元以保障锂供应。美国电动汽车龙头特斯拉也在到处做交易。

矿业资深人士米克·戴维斯（Mick Davis）现在在投资小矿商的Vision

Blue Resources工作，他怀疑所有这些交易将不足以填补资金缺口。回收利用在许多成熟的金属市场中占到了供应的四分之一，但预计在2030年之前不会对汽车电池市场有太大帮助。电池设计的调整可能会在一定程度上缓和和最稀缺金属的需求，但有可能会降低电池的性能。锂将特别难以替代。钠基阴极等无锂电池技术还有很长的路要走。

即使西方的电动汽车产业能设法获得足够的金属和电池产能，它仍将在供应链的中段面临一个巨大问题。那就是金属精炼，中国在该领域几乎享有垄断地位（见图表3）。全球近70%的锂、84%的镍和85%的钴都是中国公司精炼的。托克预测，至少在未来五年内，中国精炼镍和钴的份额都将保持在75%以上。与电池制造商一样，中国的精炼厂大量使用高污染的煤炭发电。除此之外，据托克预计，欧洲和北美公司还将依赖外国供应商提供至少一半将精炼矿石转化为电池材料的产能，而且通常依赖的是中国供应商。

西方政府明白多元化供应渠道的迫切性。去年，美国总统拜登公布了国内电池供应链的蓝图。他在2021年获得通过的庞大基础设施法为美国的电池制造拨款30亿美元。他于8月16日签署成为法律的《降低通胀法案》（Inflation Reduction Act）还包括对该行业的税收抵免政策，条件是矿石、精炼材料和组件必须来自美国或其盟国。欧盟于2017年成立了一个电池联盟以协调公共和私营部门的努力，欧盟表示去年在整个电池供应链上投资了1270亿欧元，预计到2030年将再投资3820亿欧元。其中大部分可能会投入到供应链下游，帮助西方在2027年实现成品电池的自给自足。

这是不小的手笔。而新发现的矿床、更好的采矿技术、更巧妙的电池化学构成和牺牲部分性能可能会共同作用，帮助市场达到平衡。但更可能的情况是，如大宗商品顾问让-弗朗索瓦·兰伯特（Jean-François Lambert）所说，电动汽车行业“将在相当长的一段时间内生活在一个巨大的谎言之中”。 ■



The age of discovery

Damião de Góis and Luís de Camões embodied contrasting world views

Edward Wilson-Lee's double biography is also a chronicle of debates in Renaissance thought

A History of Water. By Edward Wilson-Lee. William Collins; 352 pages; £25

“MANY HISTORIANS begin their chronicles by praising history, but these praises always sell the matter short,” wrote Damião de Góis, a Portuguese royal archivist, in his account of the reign of Manuel I, published in 1566-7. “History is infinite,” de Góis reckoned, “and cannot be confined within any limits.”

It is an unusual manifesto for a chronicle, one of history’s drier literary forms. But to fulfil his expansive vision of his task, de Góis ranged freely across everything from the history of the Shia faith to the scholarship of Queen Mother Eleni of Abyssinia. Edward Wilson-Lee applauds such generous curiosity; in some ways he seeks to replicate it. His new book, “A History of Water”, is in part an exploration of de Góis’s life and thought, but it is also an argument for globalisation, for openness and undogmatic ideas about the world.

De Góis was well-travelled. As a young man in the 1520s he worked in the great mercantile city of Antwerp; later he went on diplomatic trips to Denmark, Poland, Prussia and Russia. His adventures exposed him to the intellectual ferment of the era. He lived with Erasmus in Freiburg, working as the elderly philosopher’s secretary. He dined with Martin Luther in Wittenberg. Ignatius Loyola, the founder of the Jesuits, visited de Góis in Padua.

He travelled farther still in his reading and writing. Portugal had initiated

the age of exploration and was, in this period, the primary conduit—for goods, information and, less happily, people—between Europe and the rest of the globe. The royal archive in the Torre do Tombo, the Tower of Records, was a central clearing-house for Europe’s awareness of the world beyond. De Góis, always drawn to marginal voices and ideas, had access to it all. In the Tower of Records he contemplated “the chaotic fullness of the world”.

Even in the 16th century, globalisation was provoking a reaction. Luther grumbled that “foreign trade...would not be permitted if we had proper government and princes”. When de Góis ate with him, he was served hazelnuts and apples: local produce free from ornament, ostentation and otherness. In this and other subtle ways, the book addresses the wider intellectual debates of the Reformation and of humanist and Renaissance thought.

Mr Wilson-Lee interleaves the life of de Góis with that of his contemporary, Luis de Camões, the author of “The Lusiads”, an epic poem celebrating Portugal’s voyages of discovery. Often in prison and always in penury, de Camões led a violent, disreputable existence. He spent 17 years in exile in far-flung Portuguese trading posts in Goa, Macau, Mozambique and elsewhere.

While de Camões may have briefly worked under de Góis, Mr Wilson-Lee is less interested in how their lives intersected than how they embodied Europe’s different responses to its discoveries. “A History of Water” artfully juxtaposes the confined spaces inhabited by its subjects—de Góis in his tower and de Camões in his various prisons—with the period’s great intellectual investigations. Where de Góis widened his horizons to let more of the world in, de Camões took his narrowness with him: he framed Portugal’s voyaging as a reclaiming of a classical destiny and a triumph over pagan disorder. The Inquisition arrested de Góis in 1571, aged almost 70, as his Catholicism was too diluted for their liking. It imprisoned him for 19

months, interrogating him throughout.

“A History of Water” explores European bafflement and fear at new ideas, and the book itself presents as a puzzle within a puzzle. It opens with the accidental death—or perhaps murder—of de Góis in January 1574, soon after the Inquisition released him. Sources described him as burnt to death, or strangled; Mr Wilson-Lee offers his own provocative account.

The author ponders the questions posed by a moment in history when societies “might have become global”—that is, might have embraced pluralism, as de Góis did—“but didn’t”. He resists offering simplistic answers as to why Europe chose its imperial course, yet there are many things to wonder at in the book’s pages, as well as some things to despair of. The journey is enthralling throughout—as all explorations should be. ■



大发现年代

德戈伊斯和卡蒙斯体现了对比鲜明的世界观

爱德华·威尔逊-李的这本双人传记也是一部文艺复兴思想辩论的编年史【《水的历史》书评】

《水的历史》，爱德华·威尔逊-李著。威廉柯林斯出版社，352页，25英镑。

“许多历史学家在他们编年史的开篇总要先把历史赞美一番，却又往往夸不到位。”葡萄牙皇家档案员达米昂·德戈伊斯（Damião de Góis）在1566至1567年间出版的关于曼努埃尔一世（Manuel I）统治的著述中写道。“历史是无限的，”德戈伊斯认为，“不能把它塞进任何框框里。”

作为历史记载中一种比较枯燥的形式，一部编年史发出这样的宣言不同寻常。但是，为符合自己设定的恢宏视野，德戈伊斯肆意挥洒，从什叶派信仰的历史，写到阿比西尼亚王母埃莱尼（Eleni）的学术研究，包罗万象。爱德华·威尔逊-李（Edward Wilson-Lee）赞许这种充沛旺盛的好奇心，在某种程度上他也试图效仿。他的新著《水的历史》（A History of Water）既是对德戈伊斯的人生和思想的探索，也是对全球化、开放性，以及非教条的世界观的倡导。

德戈伊斯游历甚广。十六世纪二十年代，年轻的他曾在伟大的商业城市安特卫普工作；后来他又前往丹麦、波兰、普鲁士和俄罗斯开展外交访问。他的探险之旅使他接触到了那个时代涌动的思潮。他和伊拉斯谟一起住在弗莱堡，担任这位年迈哲学家的秘书。他和马丁·路德在威滕贝格共进晚餐。耶稣会的创始人伊纳爵·罗耀拉（Ignatius Loyola）在意大利帕多瓦拜访过德戈伊斯。

他在阅读和写作中走得更远。当时葡萄牙已经开启了探索时代，在这一时期成为了欧洲和世界其他地区之间交换商品、信息的主要通道——还有不那么叫人高兴的人员流动的通道。在东波塔（Torre do Tombo，也就是档

案塔)的皇家档案馆成了欧洲对外部世界认知的信息交流中心。一向被非主流声音和思想吸引的德戈伊斯可以接触到所有这些信息。在档案塔中,他思索着“这个世界混乱的全貌”。

即使在16世纪,全球化也已经引发了一些抗拒。路德抱怨道:“如果我们像样的政府和君主,绝不会允许.....对外贸易。”当德戈伊斯与他用餐时,拿上来的是榛子和苹果,这些本地农产品不带任何装饰、排场和异域风味。通过这种细节和其他微妙的手法,本书触及了有关宗教改革、人文主义和文艺复兴思想的更广泛思辨。

威尔逊-李在记述德戈伊斯的人生时插入了他的同时代人卡蒙斯(Luis de Camões)的故事。卡蒙斯写下了歌颂葡萄牙发现之旅的史诗《卢济塔尼亚人之歌》(The Lusiads)。他时常身陷囹圄,总是穷困潦倒,一生充满暴力和污名。他在海外流亡了17年,足迹遍及遥远的果阿、澳门、莫桑比克等地的葡萄牙商栈。

卡蒙斯可能曾在德戈伊斯手下短暂工作过,但不论两人的生活如何交织,威尔逊-李更感兴趣的是他们身上体现的欧洲对它的探索发现的不同反应。《水的历史》巧妙地将主人公所处的逼仄空间——德戈伊斯在塔楼内,卡蒙斯在各式囚牢里——与那个时期伟大的知识探究对比映照。在德戈伊斯打开视野、纳入更广大世界之处,卡蒙斯以狭隘的视角固步自封:他把葡萄牙的远航记叙成回归天命,以及对异教动乱的胜利。1571年,宗教裁判所逮捕了年近70的德戈伊斯,认为他的天主教信仰已经过于淡薄。他被监禁了19个月,终日受审。

《水的历史》潜入欧洲人面对新思想的困惑和恐惧,而这本书本身就像一个谜中谜。它以德戈伊斯的意外身故——也可能是被谋杀——开篇,当时是1574年1月,他刚从宗教裁判所释放不久。在一些人口中,他是被烧死或勒死的;威尔逊-李给出了他自己的刺激神经的版本。

作者思索了一个特定的历史时刻带出的问题,当时社会“本可能变得全球化”——也就是像德戈伊斯那样拥抱了多元主义——“结果却并没有”。欧洲

为何选择了帝国道路？他拒绝给出简单化的答案。不过，除了一些叫人绝望之事，书中也有许多令人惊叹之处。这是一段全程扣人心弦的旅程——所有探索本应如此。 ■



Free exchange

America v Europe: A comparison of riches leaves both sides red-faced

Lessons from David Hockney's mother

WHEN DAVID HOCKNEY'S mother visited the British artist in Los Angeles she made an observation that points to the difficulties with transatlantic economic comparisons. "Strange," she said, after a couple of days in the sun, "all this lovely weather and you never see any washing out."

It is an observation many European visitors have echoed. American travellers to Europe, meanwhile, often despair at washer-dryer machines that leave clothes damp. Indeed, for some American writers the lack of standalone dryers is symbolic of the continent's backwardness. While economic statistics should solve such debates—by allowing for apples-to-apples comparisons—they are not immune to the problems posed by cultural differences. Is it that Europeans cannot afford proper tumble dryers? Or are they simply getting their "drying services" free of charge?

Questions like these are important when comparing countries. On the surface, America has by far the best case for prosperity. Gross domestic product (GDP) per person is almost \$70,000. The only European countries where it is higher are Luxembourg, Switzerland, Norway and Ireland, where figures are distorted by firms' profit shifting. In Germany, Europe's economic powerhouse, GDP per person (adjusted for purchasing-power parity) is \$58,000. That puts it level with Vermont, but far below New York (\$93,000) and California (\$86,000). The comparisons are even less flattering for other European countries. Incomes in Britain and France are equal to those in Mississippi (\$42,000), America's poorest state.

Yet a lot is hidden by these figures. To understand why, consider how they are calculated. Spending is deflated by some measure of price, to allow

accurate comparisons between countries of the amount of goods and services purchased. For manufactured goods this is a straightforward calculation: the amount Americans spend on dryers, divided by an index of their cost, will give a pretty accurate figure for total consumption.

For services, it is harder to work out a reasonable deflator. And that matters because it is here, rather than household appliances, where Europe and America differ most. Combined spending on health care, housing and finance accounts for about half the difference in consumption between America and the biggest European economies. In 2019 Americans consumed \$12,000-worth of health services per person; Germans managed just \$7,000.

The difficulty in working out a reasonable deflator is partly conceptual. What are people paying for when they buy health care, a service or an outcome? Is a unit of “health-care services” the cost of a specific treatment or the cost of health? What does being healthy even mean? International price indices simply (and a little unsatisfactorily) calculate the price per treatment. These differ substantially. The OECD, a club of mostly rich countries, estimates that a hip replacement in Norway costs seven times as much as one in Latvia and Lithuania. In any case, while American prices are higher than European ones, the gap is not big enough to account for the difference in health-care consumption: Americans also undergo lots more medical treatment.

Simon Kuznets, a Nobel-prize-winning economist and statistician, suggested estimates of GDP should exclude things an “enlightened social philosophy” would consider harms rather than benefits. For him, that included weapons, advertising, much of finance and anything necessary to “overcome difficulties that are, properly speaking, costs implicit in our economic civilisation”.

Many Europeans would suggest this category rightfully includes American health-care spending. Life expectancy in America is five years lower than in Italy; lots of money is spent fixing the damage done by higher levels of violent crime, traffic accidents and obesity. Follow Kuznets's advice—by removing from the calculation finance, health, public administration and defence spending—and the gap between America and Germany in GDP per hour worked drops from \$11 to just \$4.

Much of the remaining gap is accounted for by “housing services”, a category of consumption similarly bedevilled by conceptual difficulties. International comparisons are done on the basis of the rental cost per square metre. That flatters sparsely populated America and its sprawling cities, where rents are generally cheaper. While nearly everyone would rather have a bigger house, preferences for suburban over urban living are hardly universal.

| *Top dollar*

There are diminishing returns to America's spending on health care. But treating all of it as an additional cost would be a mistake. Cancer survival rates are higher in America than Europe. Health-care spending can be considered a luxury good that a richer country may choose to spend more on (Germany, Norway and Switzerland spend the most in Europe). Meanwhile, as American defence hawks like to point out, Europe's low military spending is possible only thanks to America's largesse and the security it provides.

America has other genuine advantages. The combination of higher productivity and the fact that workers spend more time at work allows Americans to enjoy greater quantities of consumer electronics, cars, furniture and clothes. The only categories in which Germans and the French consistently consume more are education, spending abroad, and food and drink, suggesting there is something to stereotypes of Europe's

cosmopolitan café culture and America's infatuation with consumer goods.

Still, while arguments can be made for Europe, there is no way of slicing the data, despite your columnist's best efforts, to make the continent's biggest economies richer than America. Even in the areas where Europe does consume more than America, the old-world economies are not ahead by much. Maybe the true lesson of the comparison is that neither side ought to be satisfied: Europeans should be unhappy with their lower incomes; Americans really should be getting a lot more from their riches. ■



自由交流

美欧斗富，都失了颜面

来自大卫·霍克尼母亲的启迪

当大卫·霍克尼（David Hockney）的母亲到洛杉矶探望这位英国艺术家时，她的一句感叹突显了要比较大西洋两岸的经济水平有多难。“奇怪了，”享受了几天阳光后她说，“这么好的天气，居然一点洗晒的东西都看不到。”

许多欧洲游客都曾发出同样的疑问。与此同时，去欧洲的美国游客常常对那里的洗烘一体机感到绝望——拿出来的衣服都是潮乎乎的。一些美国作家甚至觉得没有独立的烘干机正象征了欧洲大陆的落后。虽然经济统计应该可以通过比较一些可比较的事物来解决有关贫富的争论，它们也并不对文化差异带出的问题免疫。欧洲人是买不起正经的滚筒式干衣机吗？还是他们其实是在享受免费的“烘干服务”？

在国家间做比较时，像这样的问题很重要。从表面上看，美国绝对是繁荣的最佳例证，人均GDP接近7万美元。在欧洲只有卢森堡、瑞士、挪威和爱尔兰的人均GDP比这更高，但它们的数字因为企业的利润转移而失真。欧洲经济强国德国的人均GDP（经购买力平价调整）为5.8万美元，与佛蒙特州持平，但远低于纽约州（9.3万美元）和加州（8.6万美元）。其他欧洲国家也来参与比较的话就更加颜面无光了。英国和法国的收入水平与美国最穷的州密西西比州（4.2万美元）持平。

然而，这些数字中隐藏了很多东西。要了解原因，就要看它们是如何计算的。支出要由某种价格指标做平减，才能精确地比较不同国家购买的商品和服务量。对于制成品来说这是个简单的计算：把美国人花在烘干机上的钱除以它们的价格指数，就会得出一个相当准确的总消费数字。

要给服务业计算出一个合理的平减指数难度就大了。而这很重要，因为欧美间最大的不同正在于此，而不在家用电器上。美国和欧洲最大经济体之

间的消费额差异大约有一半源自它们在医疗、住房和金融方面的总支出。2019年，美国人均医疗服务的消费额为1.2万美元，德国人只花了7000美元。

要制定一个合理的平减指数，困难一定程度上源自概念上的界定。当人们购买医疗时，他们是在为什么付费？是服务还是结果？一个单位的“医疗服务”是指具体某次治疗的成本，还是获得健康的成本？到底怎样算健康？国际价格指数只是简单地（而稍显不足地）计算了每次治疗的价格。而这方面差别很大。主要由富裕国家组成的经合组织估计，在挪威做髌关节置换手术的费用是在拉脱维亚和立陶宛的七倍。不管怎样，虽然美国的价格比欧洲更高，但这一差距没有大到足以解释医疗消费的差异：美国人接受的治疗也多得多。

诺贝尔经济学奖得主、统计学家西蒙·库兹涅茨（Simon Kuznets）建议，对GDP的估算应该排除“开明的社会哲学”会认为有害而非有益的东西。在他看来，这包括武器、广告、大部分金融以及任何“解决难题所必须的东西，这些难题确切来说就是我们经济文明中隐含的成本”。

许多欧洲人会认为这一类别理所当然要包括美国的医疗支出。美国的预期寿命比意大利少五年；大量资金被用于修复由更高水平的暴力犯罪、交通事故和肥胖造成的损害。按照库兹涅茨的建议——将金融、医疗、公共管理和国防支出排除在计算之外——美国和德国每小时劳动产生的GDP的差距就从11美元下降到仅仅4美元。

差距的其余部分在很大程度上是“住房服务”造成的，这个消费类别同样有难以界定概念的困扰。国际上的比较是以每平方米的租金为基础，这更利于人口密度低的美国及其不断扩张的城市在对比中胜出，那里的房租通常都更低。虽然世人几乎都愿意住更大的房子，但偏好郊区生活更胜城市却不是共通的。

| 大价钱

美国医疗支出带来的回报正在减少。但把这部分支出全部都视为额外成本

将是个错误。美国的癌症存活率高于欧洲。或许可以把医疗支出视作一种奢侈品，更富裕的国家可能会选择在这方面花更多的钱（德国、挪威和瑞士的支出为欧洲最多）。与此同时，正如美国国防鹰派总爱指出的那样，欧洲军费开支不高全都多亏美国的慷慨，还有它提供的安全保障。

美国还有其他真正的优势。生产率更高和劳动者工作时间更长使得美国人能够享受更多的消费电子产品、汽车、家具和服装。德国人和法国人消费水平始终都更高的类别只有教育、海外支出以及食品饮料，这表明欧洲咖啡馆文化遍地开花和美国迷恋消费品的刻板印象是有一定道理的。

然而，尽管可以为欧洲说一些话，但笔者用尽浑身解数也没有办法将数据切分，让欧洲大陆最大的那些经济体显得比美国更富裕。就算是在欧洲的消费确实超过了美国的领域，旧世界经济体也没有领先多少。也许从这番比较中能得出的真正教训是双方都不应该满足。欧洲人应该对他们收入更低的局面感到不满，而美国人的财富带给他们的真的应该远不止他们已得到的那些。■



Buttonwood

How should investors prepare for repeat inflation shocks?

Forget transitory v persistent. The new fear is that price pressures are “structural”

BUY STOCKS so you can dream, buy bonds so you can sleep—or so the saying goes. A wise investor will aim to maximise their returns relative to risk, defined as volatility in the rate of return, and therefore hold some investments that will do well in good times and some in bad. Stocks surge when the economy soars; bonds climb during a crisis. A mix of the two—often 60% stocks and 40% bonds—should help investors earn a nice return, without too much risk.

Such a mix has been a sensible strategy for much of the past two decades. Since 2000 the average correlation between American stocks and Treasuries has been staunchly negative, at -0.5. But the recent rout in both stock and bond prices has wrong-footed investors. In the first half of the year the S&P 500 shed 20.6% and an aggregate measure of the price of Treasuries lost 8.6%. Is this an aberration or the new normal?

The answer depends on whether higher inflation is here to stay. When economic growth drives asset prices, stocks and bonds diverge. When inflation drives them, stocks and bonds often move in tandem. On August 10th American inflation data showed prices did not rise in July. Stocks soared—the S&P 500 rose by 2.1%—and short-term Treasury prices climbed, too.

For as long as central bankers kept a lid on inflation, investors were protected. Yet look back before 2000, to a period when inflation was more common, and you see that stocks and bonds frequently moved in the same direction. AQR Capital Management, an investment firm, notes that in the 20th century the correlation between stocks and bonds was more often

positive than negative.

Lots of hedge-fund types, pension-fund managers and private-equity barons are therefore worrying about the potential for repeat inflation shocks. Last year the debate in the halls of finance was about whether inflation would be “transitory” or “persistent”; this year it is about whether it is “cyclical” or “structural”.

At the heart of this is not whether central bankers can bring down prices, but whether the underlying inflation dynamic has changed. Those in the “structural” camp argue that the recent period of low inflation was an accident of history—helped by relatively calm energy markets, globalisation and Chinese demographics, which pushed down goods prices by lowering the cost of labour.

These tailwinds have turned. Covid-19 messed up supply chains; war and sabre-rattling are undermining globalisation. Manoj Pradhan, formerly of Morgan Stanley, points out that China’s working-age population has peaked. Jeremy Grantham, a bearish hedge-fund investor, fears that the switch to renewables will be slow and costly, and that lower investment in fossil-fuel production will make it hard for energy firms to ramp up supply, increasing the risk of energy-price spikes. All this, the structuralists argue, means the current inflation shock is likely to be the first of many: central bankers will be playing whack-a-mole for a while yet.

Recurrent inflation would upend 20 years of portfolio-management strategy. If the correlation between stocks and bonds shifts from -0.5 to +0.5 the volatility of a “60/40” portfolio increases by around 20%. In a bid to avoid being wrong-footed once again, investors are updating their plans. As Barry Gill of UBS’s asset-management arm puts it, the task is “to realign your portfolio around this new reality”.

What assets will allow investors to sleep soundly in this new reality? Cryptocurrencies once looked like an interesting hedge, but this year they have fallen and risen in lockstep with stocks. A recent paper by KKR, a private asset-management firm, argues, perhaps unsurprisingly, that illiquid alternatives, like private equity and credit, are a good way to diversify. But that may be an illusion: illiquid assets are rarely marked-to-market, and are exposed to the same underlying economic forces as stocks and bonds.

There are other options. AQR suggests stock-picking strategies where success has little to do with broader economic conditions, such as “long-short” equity investing (going long on one firm and short on another). Meanwhile, commodities are the natural choice for those worried about a disorderly green transition, since a basket of them appears to be uncorrelated with stocks and bonds over long periods. In the search for new ways to minimise risk, investors dreaming of high returns will have to get creative. That, at least, should tire them out by the end of the day. ■



梧桐

投资者如何准备好迎接反复的通胀冲击？

不要再纠结是暂时性的还是持续性的。人们现在开始担心价格压力是“结构性”的

有句话大概是这样说的：想做美梦就买股票，想睡得安稳就买债券。明智的投资者会致力实现收益相对于风险（也就是回报率的波动性）最大化，因此会持有一部分在顺境时表现优异的投资，以及一部分在逆境时坚挺的投资。经济飞速发展时股票暴涨；危机期间债券价格攀升。这两者的组合——通常是60%的股票和40%的债券——应该能帮助投资者在不承担太大风险的情况下获得不俗的回报。

在过去二十年的大部分时间里，这种组合一直是一种明智的策略。自2000年以来，美国股票和国债平均稳定保持负相关性，为-0.5。但近期的股债双跌把投资者弄得手足无措。今年上半年，标普500指数下跌了20.6%，而美国国债价格的一项综合指标下跌了8.6%。这到底是反常现象还是新常态？

答案取决于较高的通胀会否持续下去。当经济增长推高资产价格时，股票和债券的表现会出现分化。但在受通胀驱动之时，股票和债券的走势往往是同步的。8月10日，美国通胀数据显示7月价格未上涨。股市应声上涨——标普500上扬2.1%，短期国债价格也攀升了。

只要各国央行能够控制住通胀，投资者就能有所保障。然而，回顾2000年之前通胀较为普遍的时期，会发现股票和债券频繁地同方向移动。投资公司AQR资本（AQR Capital Management）指出，在20世纪，股票和债券更多时候呈正相关而非负相关。

因此，多种类型的对冲基金、养老基金经理和私募股权大亨都在担心可能出现反复的通胀冲击。去年，金融界还在争论通胀到底是“暂时性的”还是“持续性的”，今年已经在争论它到底是“周期性的”还是“结构性的”。

问题的核心不在于央行行长能否平抑价格，而在于通胀的底层驱动力是否已经改变。结构派认为，前些年的低通胀只不过是历史上的偶然现象——得益于能源市场相对平稳、全球化以及中国的人口结构，后者降低了劳动力成本，从而压低了商品价格。

但这些有利因素已经逆转。新冠疫情扰乱了供应链；战争和武力威胁正在动摇全球化。曾在摩根士丹利任职的马诺杰·普拉丹（Manoj Pradhan）指出，中国的劳动年龄人口已经达到顶峰。看空市场的对冲基金投资人杰里米·格兰瑟姆（Jeremy Grantham）担心，向可再生能源的转型将会缓慢而昂贵，减少对化石燃料生产的投资将导致能源公司难以增加供应，从而增加了能源价格飙升的风险。结构派认为，所有这一切意味着当前的通胀冲击很可能只是许多轮冲击中的第一个：在未来一段时间内，央行行长将疲于奔命地应对一次又一次的冲击。

经常性通胀将颠覆20年来的投资组合管理策略。如果股票与债券的相关性从-0.5变为+0.5，那么“60/40”投资组合的波动性将增加20%左右。为了避免再次方寸大乱，投资者正在更新他们的计划。正如瑞银资产管理部门的巴里·吉尔（Barry Gill）所言，当前任务是“围绕新的现实重新校准投资组合”。

什么资产能让投资者在这个新的现实中安然入睡？加密货币一度看似一种有趣的对冲工具，但今年它们也与股市同步涨跌。私人资产管理公司KKR最近发表的一篇文章认为，像私募股权和信贷这样的非流动性替代品是实现多样化的好方法，这或许并不令人意外。但这可能是一种错觉：非流动性资产很少按市标价，而且和股票及债券一样，也会受到基本经济力量的左右。

还有其他选择。AQR建议采用选股策略——其成功与整体经济环境关系不大——例如“多-空”股票投资（做多一家公司的同时做空另一家）。与此同时，如果担心绿色转型之路崎岖难行，大宗商品是自然之选，因为在较长的时间维度里，一篮子大宗商品似乎与股票和债券并不相关。梦想着高额回报的投资者将不得不绞尽脑汁，寻找新的方法来降低风险。至少这样一

来，他们在睡前也就精疲力竭了。■



Joule in the rain

The Emirates hope to jolt clouds into sharing their bounty

No one is entirely sure whether it works

ESPECIALLY IN THE summer months, life in Dubai can feel like a denial of nature. The malls, the hotels, even the swimming pools are frosty. But the air outside is baking, with temperatures above 40°C and humidity so thick it fogs glasses and seeps from air-conditioning vents.

The United Arab Emirates (UAE), a seven-member federation of which Dubai is part, wants to put some of that humidity to use. The country has one of the world's keenest cloud-seeding programmes, flying some 200 missions a year from an airfield in Abu Dhabi, the capital. Every week or two, planes zip into the clouds to try to squeeze out a shower. Lately they have been joined by experimental drones: if nature will not share rain of its own accord, the UAE hopes to jolt it into compliance.

Cloud-seeding has been practised for almost a century. South-East Asian countries use it to clear dry-season haze; ski resorts in America to help carpet the slopes with snow. China tried it during the summer Olympics in 2008. Officials wanted to cajole clouds into casting out their contents before they reached Beijing—and ruined the festivities.

In the early days planes would dump dry ice into clouds. Today they carry chemicals, usually silver iodide or other salts. They are meant to attract water droplets, in the hope they become heavy enough to fall to earth as rain. Whether this works is not clear. A study partly funded by America's National Science Foundation found that cloud-seeding boosts snowfall under the right conditions. Studies in America, Israel and elsewhere were inconclusive.

The UAE hopes it works. One of the driest countries on earth, it sometimes has less than 100mm (four inches) of rain a year. There are occasional rainy days in winter and brief downpours in summer that break the oppressive humidity. But nature does not provide enough water for a population of about 10m people that is still growing. Most drinking water comes from the sea. So much so that 14% of the world's desalinated water is produced in the UAE.

Climate change might supply a bit more water from the heavens. Over the New Year weekend, parts of the UAE logged as much as 142mm of rain, more than a year's worth, in just three days. Locals saw it as an auspicious start to the year: the Prophet Muhammad considered rain a blessing.

Summer has also brought unusual weather, less cheerfully. Fujairah, on the east coast, saw a freak storm in July that flooded houses and washed away cars. Seven people died. Scientists say climate change may have played a role.

Still, even a rainier UAE will not be rainy enough. Last year the government started fiddling with drones. Instead of dropping chemical payloads into clouds, they deliver an electric shock. The jolt, in theory, could cause droplets to clump together: the same result as old-fashioned cloud-seeding, but without the chemicals.

The UAE insists the chemical version works, even if other researchers are less sure. For Dubai's residents, however, the programme has become something of a running jest. A day at the beach ruined by a freak storm is not simply bad luck; it might merit a complaint to the government. ■



电生雨

阿联酋想要电击云朵取甘露

这是否有效尚无定论【新知】

在迪拜生活是一种反自然的体验，尤其是在夏季。商场、酒店，甚至游泳池里都凉飕飕的。但室外的空气却炙热难耐，温度超过40°C，同时异常潮湿，使得眼镜起雾，连空调通风口也会滴水。

由包括迪拜在内的七个酋长国组成的联邦国家阿联酋想利用一下这样的潮湿气候。该国在尝试人工增雨方面乐此不疲的程度在全世界数一数二，每年从首都阿布扎比的一个机场执飞约200次任务。每隔一两个星期，飞机就会飞进云层，试图引发一场阵雨。最近，实验性的无人机也加入进来：如果大自然不肯乖乖降雨，阿联酋就要用电击让它服从。

人工降雨已有将近一个世纪的历史。东南亚国家用它来清除旱季的雾霾；美国的滑雪场用它来为山坡铺上积雪。中国在2008年夏季奥运会期间也尝试过人工降雨：官员希望让云团到达北京之前将水分耗尽，以免破坏庆典。

在早期，飞机会向云层中倾撒干冰。如今，它们通常携带碘化银或其他盐类化学品。使用这些物质是为了吸引水滴，以让它们变重，直到以雨的形式落到地面。这种做法是否有效尚不明确。一项由美国国家科学基金会部分资助的研究发现，在适当的条件下，人工降雨可以增加降雪量。在美国、以色列等地的研究没有得出明确结论。

阿联酋对此寄予厚望。作为地球上最干燥的国家之一，这里的年降雨量有时还不到100毫米（4英寸）。冬季偶尔有雨，夏季会有短暂大雨，打破令人窒息的潮湿。但是大自然的降水并不足以满足其一千万左右的人口（而且还在增长）所需。该国大部分饮用水来自海洋，以至于全世界14%的淡化海水都产自阿联酋。

气候变化可能会让老天爷稍微多赐甘霖。在今年元旦的那个周末，阿联酋部分地区在短短三天内有了142毫米的降雨，超过一整年的降雨量。当地人认为这是新一年的吉祥开端，因为先知穆罕默德视降雨为真主赐福。

今年夏季也有反常天气，但不那么叫人高兴。东海岸的富查伊拉（Fujairah）在7月发生了一场怪异的暴雨，淹了房屋，冲走汽车，七人丧生。科学家表示，这可能与气候变化有一定的关系。

但即使降水增多，也依然不够多。去年政府开始尝试使用无人机。它们并不往云中喷洒化学物质令其增重，而是发送电击。从理论上讲，电击可能使水滴聚拢——与传统的人工降雨效果相同，但无需使用化学品。

尽管其他研究者对化学催雨法仍抱有怀疑，阿联酋坚信它行之有效。然而，对于迪拜居民来说，这个项目已经成了坊间流行的一个玩笑。如果你在沙滩上的休闲时光被突如其来的暴雨给搅了，这不单单是不走运的事儿了——或许你是可以向政府投诉的。■



A finite problem

China's mortgage boycotts are a symptom of a broader crisis

The real threat to developers is falling sales

THE GERMAN mathematician David Hilbert once imagined a hotel with an infinite number of rooms. Even if all of the rooms were occupied, he pointed out, the hotel could accommodate a new arrival, simply by asking each guest to move into the room next door. One guest would move into a second guest's room, freeing up a spot for the new arrival. The second guest would move into a third guest's room, and so on. With an infinite number of rooms, the sequence would never end.

For years, China's property developers operated along similar lines. They would sell flats far in advance of building them. The money raised for these flats was supposedly reserved for building them, just as each room in Hilbert's hotel was supposedly reserved for an existing guest. But developers would instead use the money for other purposes, such as buying land. When the time came to pay for construction, they would sell more unbuilt flats and use that money instead. Just as Hilbert's hotel accommodated each guest in the room next door, China's property developers built each pre-sold flat with the money from the next pre-sale. As long as there were always new buyers, the sequence could go on.

Unfortunately, China's developers are now running out of rooms. Their sales in the 12 months to June fell by 22% compared with the previous 12 months. Advance sales fell even faster (see chart). This painful brush with finitude has left many developers without enough cash to continue building the flats their customers have already bought. China's developers have started work on over 6bn square metres of property in the past three years. They have completed less than half that amount. In the past homebuyers could do little about these delays. They had already handed

over their money, after all.

But although they have paid their developers, they are still paying their banks. In recent months, angry homebuyers have threatened to stop repaying their mortgages if developers do not resume work on their flats. According to a crowdsourced document circulating online, this mortgage strike has spread to nearly 100 cities and over 320 projects, including a Dragon City, a Peacock City and a Phoenix City. Over 40 of these projects are in Zhengzhou, the capital of Henan province.

How widespread could boycotts become? There are some limits to their growth. Striking mortgage-holders could end up on credit blacklists, damaging their access to loans. And in China, points out S&P Global, a ratings agency, most individuals cannot declare bankruptcy, since “their debts will never be forgiven”.

In a gloomy scenario, mortgage loans worth about 2.4trn yuan (\$350bn) could turn sour, reckons S&P Global. That amounts to roughly 1.3% of total bank loans, enough to endanger some smaller lenders, but not enough to pose a systemic threat to the banking system.

The true significance of the boycotts lies elsewhere. They show that Chinese households no longer believe that a flat bought in advance will necessarily be delivered. This loss of faith is not confined to the protesters. It is also showing up in weakening pre-sales, especially for distressed developers. A reluctance to buy new homes poses a bigger threat to China’s economy than the more conspicuous refusal to repay existing mortgages. Weak sales will further squeeze the revenues of developers, adding to construction delays and deepening disillusionment.

How can this vicious circle be broken? In Henan, two state-owned enterprises (a developer and a “bad bank”) have set up a relief fund to

acquire distressed projects and see them through to completion. But China's local governments lack the cash to revive confidence, according to Andrew Batson of Gavekal Dragonomics, a research firm. He believes a credible plan will require the central government to step in. It is understandably reluctant to plough more resources into a sector that already commands too big a share of the economy. But new money invested in stalled projects could yield a double dividend, helping both to build unfinished flats and to rebuild confidence in pre-sales.

In the longer term, China's developers need a less frenetic business model. They will have to rely less on selling flats in advance and starting the next project before finishing the last. In China, the demand for housing is vast. But it is not infinite. ■



一个有限问题

中国的停贷潮是一场更大危机的征兆

开发商面对的真正威胁是销量下降

德国数学家大卫·希尔伯特（David Hilbert）曾经设想过一家拥有无限多个房间的酒店。他指出，即使所有房间都客满了，这家酒店也还是能再住进一位新客人，只要请每位房客都搬进隔壁房间就好。第一位房客搬进第二位房客的房间，为新来的客人腾出位置。第二位房客搬进第三位房客的房间，以此类推。既然酒店拥有无限多的房间，这个腾挪的链条就没有尽头。

多年来，中国的房地产开发商就是沿着类似的路线运作。他们会在盖楼之前很久就预售房屋。收到的房款按说应该用于建造这些楼房，就像希尔伯特的酒店里每个房间照理要保留给某位现有房客一样。但开发商却把这些钱用在其他用途上，例如买地。到了要支付建设费用的时候，他们会出售更多的未建楼房，用所得资金支付这些费用。就像希尔伯特的酒店把每位房客都挪到隔壁房间一样，中国的房地产开发商用下一个预售项目的钱来建造当前的预售项目。只要总有新买家，这个链条就可以一直延续下去。

不幸的是，中国的开发商现在“房间”不够了。截至今年6月的12个月中，他们的销售量比之前12个月下降了22%。预售量下降得还要快（见图表）。受困于有限的腾挪空间，许多开发商已经没有足够的现金继续建造已售出的房屋。在过去三年里，中国的开发商已开工的房屋超过60亿平方米。目前完工的不到一半。在过去，购房者对楼盘延期交付基本上无可奈何。毕竟房款都已经交了。

但是，虽然他们已经向开发商支付了房款，但还是在偿还银行贷款。最近几个月，愤怒的购房者表示，假如开发商不复工，他们将停缴房贷。据网上流传的一份由很多人合力整理的文件，这一停贷潮已蔓延到近100个城市，涉及320多个楼盘项目，包括分别名为龙城、孔雀城、凤凰城的三个楼盘。这些项目中有40多个位于河南省省会郑州。

这些集体抵制会扩大到什么程度？还是会有一些限度。拒不还贷的购房者可能会被列入失信黑名单，影响日后申请贷款。评级机构标普全球指出，在中国，大多数个人不能宣布破产，因为“他们的债务永远不能豁免”。

标普全球认为，悲观的展望是，约有24万亿元房贷可能变成坏账。这大约相当于银行贷款总额的1.3%，足够危及一些小银行，但不足以对银行体系构成系统性威胁。

停贷抵制的真正影响在其他方面。它们显示中国家庭不再相信预售的房屋最后一定能交付。这种信心的丧失不限于这群抗争者。它还显现在预售疲软中，特别是那些陷入困境的开发商。相比更扎眼的拒付既有房贷行动，不愿购买新房对中国经济构成更大的威胁。疲软的销售将进一步挤压开发商的收入，加剧建设延误，加深幻灭感。

如何才能打破这种恶性循环？在河南，两家国有企业（一家开发商和一家“坏账银行”）设立了一个纾困基金，收购问题项目，盘活楼盘确保完工。但研究公司龙洲经讯（GaveKal Dragonomics）的白安儒（Andrew Batson）表示，中国地方政府缺乏资金来恢复信心。他认为一个计划要能令人信服需要中央政府的参与。对于一个已经在经济中占比过高的行业，中央不愿意投入更多资源是可以理解的。但是，向烂尾项目投入新资金可以产生双重红利，既能帮助楼盘完工，又能帮助重建人们对房屋预售的信心。

长远来看，中国的开发商需要一个不那么狂热的商业模式。他们将不得不减少依赖房屋预售，不能总是前一个项目还没完工就启动下一个。在中国，住房需求是巨大的，但不是无限的。■



Spend or save?

An oil windfall offers Gulf states one last chance to splurge

Dubai wants jobs in the metaverse; Saudi Arabia a city in the desert

IN THE NORTH-WESTERN corner of Saudi Arabia, not far from the mouth of the Gulf of Aqaba, sits a patch of mostly bare desert—the ostensible location of Neom. This would-be city is intended to be a bold step into the future, and the showpiece of the kingdom's attempt to diversify its economy away from oil. There has been talk of robots doing menial work, beaches lined with crushed marble and fleets of drones forming an artificial moon. One recent whim is to create the world's longest buildings; like skyscrapers laid flat, these self-contained ecosystems would stretch for more than 100 miles. Estimates suggest the city could cost as much as \$500bn.

When this wild dream was first unveiled in 2017, financing it seemed near impossible. Now a torrent of oil money may allow Saudi Arabia to get things rolling. The world economy's recovery from covid-19, and Russia's invasion of Ukraine, have pushed up oil prices, triggering a staggering transfer of wealth from global consumers to fuel-exporting countries. From January to June, the price of a barrel of Brent crude rose from \$80 to more than \$120 (it is back below \$100 today). The IMF estimates that energy exporters in the Middle East and Central Asia will this year net \$320bn more in oil revenues than it had previously expected, a figure equivalent to about 7% of their combined GDP. Over the next five years, the cumulative surplus could reach \$1.4trn.

Gulf leaders must now work out how to spend the proceeds of what could be the last big gush of oil wealth. Some promise to pay down debts and save for a post-petroleum future. Yet there will be pressure to share the bounty with the public—and few checks on those who wish to splash out on mega-

projects or global influence. The impact in diplomatic circles is already visible. On a visit to Jeddah in July America's President Joe Biden bumped fists with Muhammad bin Salman, the Saudi crown prince. Mr Biden had until recently kept the prince at arm's length; the current political imperative to bring down petrol prices leaves little room for moral stances.

Expensive oil augments the financial power of the Gulf states at home and abroad, opening a gusher of public spending and steering flows of money around the world. The long rise in oil prices in the 2000s helped fuel huge global imbalances, depressed interest rates and attracted a stream of supplicants looking to curry favour. Cheap oil brings shrinking ambitions. When the last sustained period of high prices ended in 2014 it seemed as if the old social contract, which promised hefty subsidies and cushy lifetime gigs in the public sector, would have to change. There was talk of diversification, higher domestic fuel and food prices—even taxes.

A period of rock-bottom oil prices, and the hit from covid, saw fiscal positions deteriorate. This year's windfall offers an opportunity to strengthen them (see chart 1). Bahrain's public debt rose to 130% of GDP in 2020, but the country's budget is based on the assumption that oil will fetch a mere \$60 a barrel. High prices may allow it to reduce its debt ratio by about 12 percentage points this year, even though it is the smallest producer in the Gulf Co-operation Council (or GCC, a group that also comprises Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates). Oman's debt burden is projected to fall by more than 20 percentage points of GDP.

Other leaders aim to save much of their earnings. Mohammed al-Jadaan, the Saudi finance minister, says his government will not touch its oil bonanza, at least this year. It will put away the money at the central bank, then use it in 2023 to replenish foreign reserves or top up the Public Investment Fund (PIF), the sovereign-wealth fund that has become the

kingdom's main driver of investment. Bahrain will use some of its surplus to refill a fund meant to provide for future generations, which it drained during the pandemic.

Yet the pressure to spend will be intense. Gulf economies have not been as squeezed by soaring prices as the rest of the world. The IMF expects inflation in the GCC to peak at 3.1% this year, well below levels in America and Europe. Abundant, cheap foreign labour keeps wage costs low. Most countries rely on fuel subsidies to limit inflation. A strong dollar, meanwhile, holds down the cost of imports (five of the six GCC members peg their currencies to the greenback).

| *Under the pump*

Residents in the Gulf are nonetheless feeling the pinch. The UAE phased out its fuel subsidies in 2015, and petrol prices climbed by 79% from January to July, when the government raised them once again, to 4.52 dirhams (\$1.23) a litre. That is not bad by global standards, but shockingly expensive for a rich petrostate—drivers in Saudi Arabia pay half as much. In July the UAE announced that it would almost double the welfare budget for poor citizens, from 2.7bn dirhams to 5bn. Eligible families will receive stipends for housing and education, plus an allowance to offset higher food and energy costs.

With just 1m citizens, representing 10% of the total population, the UAE can afford to splurge a bit. Satisfying the citizenry will be a bigger challenge in Saudi Arabia, where two-thirds of the population of 35m are nationals. The Saudi government used past oil booms to offer more jobs and higher wages in the public sector. Doing so now would run counter to Vision 2030, an economic-diversification plan meant to shift the kingdom away from oil. Firms already grumble about how hard it is to retain talent. Many young Saudis see private-sector work as a fun distraction until a government job comes along.

Oil wealth offers other ways to shield citizens from cost pressures. In 2016 the Gulf states agreed to introduce a value-added-tax of 5%, and four have done so since (the laggards are Kuwait and Qatar). Saudi Arabia has gone much further. In 2020 it tripled VAT to 15%, hoping to offset the fiscal effects of the pandemic and low oil prices. “You have a policy tool you didn’t have before,” says Nasser Saidi, a Lebanese economist who runs an advisory firm in Dubai. “Rather than increase spending or hiring, you could lower VAT.”

Competing with such concerns is the need to think long-term: beyond the boom and, ultimately, beyond oil. At the modernist offices of Bahrain’s sovereign-wealth fund, such thoughts are sobering. “Of course we’re all happy the oil price is high, but the focus needs to stay on the non-oil economy,” says an executive. Working out what that means in practice is no easy task. Some sovereign-wealth managers in the Gulf say their mandates have become almost contradictory. They are meant to husband oil wealth for future generations, but are increasingly asked to deploy capital to fuel non-oil growth, a job that entails plenty of risk.

Gulf countries have not always done a good job of judging which risks to take. The region is littered with failed mega-projects from earlier booms. Saudi Arabia’s gleaming financial district, meant to compete with Dubai’s, was plagued by delays and cost overruns. When it was eventually finished, it sat empty: banks saw no reason to move. The UAE spent billions to create artificial islands shaped like a map of the world. More than a decade later, the archipelago is derelict. The UAE’s ambitious plans to become a semiconductor-manufacturing hub, and a centre for health tourism, have similarly fizzled out.

Wild flights of fancy like Neom stand ready to absorb a hefty chunk of the oil money this time round. Saudi Arabia also wants to host the Asian Winter Games in 2029, spraying desert mountains with snow; Dubai has a

many plan to create 40,000 jobs in the metaverse in five years. Even less ostentatious projects may prove wasteful. Saudi Arabia sees tourism as the centre of its post-oil economy, providing at least 10% of jobs and GDP. The oil boom will give the PIF billions to throw at resorts, amusement parks and other diversions. Yet Saudi officials cannot point to a proper assessment showing that its hoped-for 100m tourists will in fact choose to visit the kingdom each year. As Ali al-Salim, a Kuwaiti investor, notes: “It’s a pretty fickle business to be the linchpin of your economic plan.”

The Gulf states would be wise to focus on areas where they have clearer competitive advantages. Developing expertise in desalination techniques and technologies, much as Israel has done, could make a virtue of the region’s aridity. Investments in green-energy technologies like hydrogen could offer a source of revenues after the energy transition. Mr Saidi proposes investing in renewables projects and climate-mitigation strategies in Asia and Africa, as a green version of China’s Belt and Road Initiative. “This is a moment when you want to look again at how you provide foreign aid,” he argues.

| *Tee off*

Certainly, the boom stands to reshape the Gulf’s relations with the rest of the world—as demonstrated by Mr Biden’s trip to Jeddah. Enormous quantities of Saudi money are being spent to burnish the kingdom’s reputation in other contexts as well. The world of golf, for example, is being transformed as LIV Golf, a Saudi-backed rival to the PGA tour, lures stars with fantastical payouts. The country started hosting a Formula 1 race in 2021. Pop stars including Justin Bieber, Mariah Carey and David Guetta have recently performed in the kingdom.

The boom will also have less tangible international consequences. The GCC’s combined current-account surplus this year may run to more than \$400bn, or 0.4% of global GDP (see chart 2)—a slightly higher share of

world output than the biggest surpluses achieved before the global financial crisis of 2007-09. In past booms oil profits have been recycled into investment flows back to America (through purchases of Treasuries, for instance), funding America's current-account deficits.

Yet America has become the world's largest producer of oil, and big emerging economies have grown richer and developed a thirst for the stuff. Thus the Gulf's surplus today is matched in part by weaker balance-of-payments positions in big emerging economies. That includes China and India, but also scores of smaller countries, including a few, like Sri Lanka, for which the surge in the cost of imported oil has been crippling. High oil prices have hit the world as a whole harder than they did in the 2000s. This is because they are largely the result of interruptions to supply, especially from Russia, rather than robust growth in global demand.

More than a few governments have already approached Gulf leaders for money—albeit to meet urgent obligations rather than to greenify their economies. Like China and India, Saudi Arabia and the UAE have played a growing role lending to poorer countries over the past two decades, taking over a position once reserved for advanced economies and multilateral institutions like the World Bank. The developing crisis across low- and middle-income economies could give Gulf states significant leverage over less fortunate places, should they choose to wield it.

It may well be the last such opportunity. In poor countries and rich ones, the pain of soaring energy costs adds a new urgency to efforts to reduce dependence on fossil fuels. At the heart of the boom, the feeling is palpable. "There's a 'days-are-numbered' kind of sentiment," says Mr al-Salim, the Kuwaiti investor. "You look at the state Europe is in, I don't think they're going to allow themselves to be this vulnerable years from now." Which raises a question. Will the Gulf? ■



花钱还是存钱?

一笔石油横财让海湾国家还能最后挥霍一把

迪拜想创造元宇宙就业；沙特要在沙漠里建城

在沙特阿拉伯的西北角，离亚喀巴湾（Gulf of Aqaba）入海口不远处，是一片几乎寸草不生的沙漠。而Neom新城号称要建在这里。这座计划中的新城是对未来的大胆探索，也展示了沙特阿拉伯为摆脱对石油的依赖、实现经济多元化所做的尝试。人们谈论着把粗活累活都交给机器人，用大理石碎石铺成沙滩，用无人机群组成一个人造月亮。不久前又有人突发奇想，要在这里建造世界上最长的建筑，就像很多座平放在地上的摩天大楼，这些设施齐备、自给自足的生态系统会绵延100多英里。据估计，这座城市的造价可能高达5000亿美元。

当这个疯狂的梦想在2017年首次公布于众时，看起来似乎不可能为它筹集到资金。而现在，源源不断的石油收入可能会让沙特阿拉伯得以启动这个项目。世界经济从新冠肺炎中复苏加上俄罗斯对乌克兰的入侵推高了油价，引发全球财富以惊人的规模从消费国向燃油出口国转移。今年1月到6月，布伦特原油价格从每桶80美元上涨到120多美元（目前回落到100美元以下）。国际货币基金组织（IMF）估计，中东和中亚的能源出口国今年净赚的石油收入比之前预期的高出3200亿美元，大约相当于它们GDP总和的7%。未来五年这部分可能累计达到1.4万亿美元。

海湾国家领导人现在必须谋划清楚该如何使用这可能是最后一波石油财富的收益。一些国家承诺偿还债务，并为即将到来的后石油时代做储蓄。但政府会面临与民众分享这些收益的压力，而那些想要在超大型项目或全球影响力上挥金如土的人物又不会受到什么制约。这在外交界产生的影响已是有目共睹。7月美国总统拜登访问吉达（Jeddah）期间，与沙特王储穆罕默德·本·萨勒曼（Muhammad bin Salman）行了碰拳礼。此前拜登一直与这位王储保持距离，在眼下要把油价拽下来的政治急务面前，道德立场几乎被抛到了一边。

高油价提升了海湾国家在国内外的财力，带来了井喷式的公共支出，并引导了资金的全球流动。油价的长期上涨在本世纪头十年助推了巨大的全球经济失衡，压低了利率，也吸引来一大批摇尾乞怜者。低油价则让野心收敛。当最近一段持续高油价期在2014年结束时，旧的社会契约——承诺提供可观的补贴以及在公共部门里轻松又赚钱的终身职位——似乎不得不改变。这些国家开始谈论经济多样化，提高国内燃油和食品价格，甚至提高税收。

油价在一段时间里跌至谷底，加上新冠肺炎的打击，让这些国家的财政状况恶化。今年的意外收益为它们提供了一个改善财务的机会（见图表1）。巴林的公共债务占GDP的比例在2020年上升到130%，不过该国的预算是基于假设油价仅卖每桶60美元。尽管它是海湾合作委员会（Gulf Cooperation Council，简称海合会，还包括科威特、阿曼、卡塔尔、沙特阿拉伯和阿联酋）中最小的产油国，但高油价可能会使它今年的负债比例降低约12个百分点。阿曼的债务占GDP的比例预计将下降逾20个百分点。

其他国家的领导人则打算将大部分收入存起来。沙特财政部长穆罕默德·贾达安（Mohammed al-Jadaan）表示，沙特政府至少今年不会动用石油收益。沙特将把这笔钱存入央行，然后在2023年用它补足外汇储备或公共投资基金（PIF），该主权财富基金已成为沙特投资的主要驱动力。巴林将用其盈余的一部分补充一个旨在供养子孙后代的基金，该基金在疫情期间被耗尽。

但是，要把钱花出去的压力也会很大。海湾经济体没有受到像世界其余地区那样的物价飞涨压力。IMF预计今年海合会成员国的通胀率最高为3.1%，远低于美国和欧洲的水平。大量廉价的外国劳动力让工资成本保持在较低水平。大多数海湾国家依靠燃油补贴来遏制通胀。与此同时，强势的美元压低了进口成本（六个海合会成员国中有五个将本国货币与美元挂钩）。

| 承压

尽管如此，海湾国家的居民还是感到手头拮据。阿联酋在2015年逐步取消

了燃油补贴，该国油价在今年1月到7月间上涨了79%，政府在7月再度将油价上调到每升4.52迪拉姆（1.23美元）。以全球标准来看这样的油价还不算高，但对于一个富裕的产油国来说却是高得惊人。要知道沙特的车主支付的油费只有这个数字的一半。7月，阿联酋宣布将把面向贫困国民的福利预算增加近一倍，从27亿迪拉姆增至50亿迪拉姆。符合条件的家庭将获得住房和教育补贴，外加一项用来抵消食品和能源价格上涨的补助。

阿联酋只有100万本国公民，占总人口的10%，稍微挥霍一下还负担得起。而在沙特阿拉伯，要满足本国公民的挑战就很大了，因为他们在该国3500万总人口中占到了三分之二。在过去，沙特政府利用石油繁荣来提供更多公共部门的职位和更高的工资。而现在如果还这么做，就会与《2030愿景》（Vision 2030）这样一项想要让沙特摆脱对石油依赖的经济多样化计划背道而驰。企业已经在抱怨很难留住人才。许多沙特年轻人把私营部门的工作视为找到政府职位之前的消遣。

石油财富还通过其他途径让国民免受高成本压力。2016年，海湾国家同意引入5%的增值税，之后四个国家实施了该项税收（科威特和卡塔尔行动落后）。沙特阿拉伯在这方面走得更远。2020年，它将增值税增加了两倍，提高到15%，希望抵消疫情和低油价对财政的影响。“它们有了过去没有的政策工具，”在迪拜经营一家咨询公司的黎巴嫩经济学家纳赛尔·赛迪（Nasser Saidi）表示，“它们可以降低增值税，而不用增加支出或工作岗位。”

与这种关切相抗衡的是做长远考虑的需要——视线要超越石油繁荣期，以及最终要摆脱石油。在巴林主权财富基金那现代主义风格的办公室里，这样的想法令人警醒。“油价高企我们当然都很高兴，但我们需要把重点放在非石油经济上。”一位高管表示。要弄清这句话在实践中意味着什么并非易事。一些海湾国家主权财富基金的经理表示，自己的任务已经变得近乎矛盾。他们本来应该为了子孙后代节约使用石油财富，但却越来越多地被要求配置资本以推动非石油行业的增长，这可是一项高风险的工作。

而在判断该冒哪些风险方面，海湾国家的表现并不叫人放心。这里到处是

之前的石油繁荣期遗留下来的大型烂尾项目。沙特阿拉伯那光彩夺目的金融区本打算与迪拜一争高下，却饱受工期延误和成本超支的困扰。当它最终完工时，却无人入驻：银行认为没有理由搬迁到这里。阿联酋花费数十亿美元建造了形状好似世界地图的人工群岛，十多年后已经废弃。该国成为半导体制造中心和健康旅游中心的宏伟计划同样无疾而终。

这一次，像Neom这样异想天开的项目势必又要耗费一大笔石油收入。沙特阿拉伯还希望主办2029年亚洲冬季运动会，届时会向沙漠中的群山上撒雪；迪拜有一个古怪的计划，要在五年内创造四万个元宇宙工作岗位。即使不那么浮华的项目最后可能也只是在烧钱。沙特阿拉伯认为旅游业将是后石油经济的核心产业，将提供至少10%的就业机会和GDP。石油繁荣会给PIF基金带来数十亿美元，用于兴建度假村、游乐园和其他娱乐设施。但沙特官员无法给出一个合理的评估，以表明真的会像他们期望的那样，每年有一亿游客选择来沙特旅游。正如来自科威特的投资者阿里·阿尔萨利姆（Ali al-Salim）所指出的那样：“旅游业充满不确定性，不适合作为经济计划的关键。”

把重点放在自己竞争优势明显的领域将是海湾国家的明智之选。它们大可像以色列那样，利用海水淡化方面的专业工艺和技术，把该地区的干旱转化为优势资源。也可以投资氢等绿色能源技术，在能源转型后提供收入来源。赛迪建议投资亚洲和非洲的可再生能源项目和气候变化减缓战略，相当于中国“一带一路”倡议的绿色版本。“在这个时刻，需要重新审视如何提供对外援助。”他指出。

| 开球

毫无疑问，石油繁荣势将重塑海湾国家与世界其他地区的关系——拜登的吉达之行就显现了这一点。沙特还在斥巨资来提升自己在其他方面的声誉。例如，作为PGA（美国职业高尔夫球协会）巡回赛的竞争对手，沙特资助的LIV高尔夫邀请赛（LIV Golf）用惊人的奖金吸引明星选手，正在颠覆现有的高尔夫赛事体系。沙特还从2021年开始举办一级方程式锦标赛。贾斯汀·比伯（Justin Bieber）、玛丽亚·凯莉（Mariah Carey）、大卫·库塔（David Guetta）等流行歌手近年来都曾到沙特演出。

这轮石油繁荣还会对国际社会产生一些不太容易感知的影响。今年海合会经常项目总盈余可能超过4000亿美元，占全球GDP的0.4%（见图表2）——在世界产出中的占比略高于2007至2009年全球金融危机以前盈余最大的时期。在过去的繁荣时期，石油利润一直通过再投资回流到美国（比如通过购买美国国债），为美国的经常项目赤字融资。

然而，美国已经成为世界上最大的石油生产国，同时大型新兴经济体已变得更富有并且迫切需要石油。因此，海湾国家今天的盈余在某种程度上也就意味着大型新兴经济体的国际收支状况变糟。这其中既包括中国和印度，也包括许多较小的国家，比如斯里兰卡这样因进口石油价格飙升而受害的国家。如今的高油价对整个世界的冲击比本世纪初更严重。这是因为这次的高油价主要是供应（尤其是来自俄罗斯的供应）中断造成的，而不是全球需求强劲增长的结果。

好几个国家的政府已经向海湾国家领导人寻求资金援助——尽管是为了偿还紧急债务而不是发展绿色经济。与中国和印度一样，过去20年里沙特阿拉伯和阿联酋在向较贫穷国家提供贷款方面发挥了越来越大的作用，取代了发达经济体和世界银行等多边机构长期扮演的角色。危机在低收入和中等收入经济体不断蔓延，这可能会让海湾国家对不怎么走运的国家产生重大影响——如果它们选择运用这种影响力的话。

这很可能是最后一次这样的机会。无论在穷国还是富国，能源成本飙升带来的切肤之痛令减少依赖化石燃料的努力更显紧迫。在石油繁荣的中心地带，这种感觉显而易见。“有种‘时日无多’的氛围，”科威特的投资者阿尔萨利姆表示，“看看欧洲的现状，我想它们不会允许自己在几年后还这么被动。”这就引出了一个问题——海湾国家会吗？■



Chinese private enterprise

Meet China's new tycoons

Who is winning in Xi Jinping's economy?

XI JINPING HAS a master plan for China. Its ultimate goal is for the country to be the 21st century's dominant superpower, both feared and admired. China's increasing sabre-rattling encapsulates the desire to be fearsome. As for admiration, that is to come from growing economic and technological heft. Here, Mr Xi's plan involves a reshaping of Chinese private enterprise.

At first blush, this exercise has been painful for business. A crackdown against successful internet companies has wiped as much as \$2trn from their collective market capitalisation. On August 4th Alibaba, an e-commerce giant, reported its first ever quarterly decline in revenues. A day earlier its financial affiliate, Ant Group, revealed a slide in profits. Jack Ma, who co-founded both firms, may soon cede control of Ant. His net worth has fallen by more than \$20bn in the past couple of years. That of Hui Ka Yan, the founder of Evergrande, a troubled property giant, has crashed from \$40bn in 2020 to \$6bn. Last month Carlos Tavares, the boss of Stellantis, a carmaker (whose largest shareholder, Exor, part-owns The Economist's parent company), said that it would exit a Chinese joint-venture after complaining of "growing political interference".

Yet if you look closer the picture is more complex. Even as some businesses suffer, others are thriving in Mr Xi's China. Companies have raised a record \$58bn in initial public offerings in mainland China so far this year, according to Bloomberg, a financial-information firm, compared with just \$19bn in America and \$5bn in Hong Kong. Another 1,000 firms are reportedly lining up to go public. A fresh cohort of tycoons is emerging, too. China's ten richest magnates have accumulated a net \$167bn in wealth since the start of 2020, according to data from Bloomberg. In the past few

weeks The Economist has spoken to several of the new champions, and the mood is surprisingly upbeat.

This century China's private sector has grown from a backwater into one of the most dynamic in the world. According to the Peterson Institute for International Economics (PIIE), an American think-tank, by 2020 privately controlled companies accounted for more than half of the market capitalisation of China's 100 biggest listed firms, compared with less than a tenth a decade earlier. The private sector employs four in five urban workers, or around 150m all told. Thirty-two private Chinese companies feature in the Fortune 500 ranking of the world's biggest firms by revenue, up from none in 2005.

The march from Maoism to markets has been long and arduous. Until 1992 "entrepreneurs were looked down upon", recalls Zheng Chunying, back then a government functionary in Liaoning province. But China was buzzing with talk of change and its ailing leader, Deng Xiaoping, had just reaffirmed the government's commitment to economic reforms. Liaoning's local government began encouraging officials and Communist Party members to start their own firms. Mr Zheng became the proud co-owner, with his wife and sister, of a small shop that sold imported clothing from Hong Kong and shoes from Europe. When in 1996 officials were suddenly banned from running businesses, he quit his government job rather than closing his shop.

He was one of a cohort who chose business over bureaucracy. His decision was vindicated in 2002, when the party constitution was amended to let businesspeople become members. After that China Inc went from strength to strength. Entrepreneurs cite the first five years of Mr Xi's leadership between 2012 and 2017 as the heyday of private enterprise. Technology groups such as Alibaba and Tencent and conglomerates like HNA and Dalian Wanda rose to global prominence. Their founders became

household names—and amassed Croesus-like riches.

Five years ago the mood began to shift. First came a swift crackdown on the conglomerates, some of which subsequently went bust (for example, HNA) or were nationalised (Anbang, a big insurer). Then thousands of privately run shadow banks were shut down. In the past two years came the turn of the tech giants, slapped with regulatory probes, fines and tough new rules on everything from user data to the treatment of workers, and of property firms, whose ability to take on new debt began to be restricted by the government. Last year the private sector's share of the market value of China's 100 largest companies fell for the first time (see chart 1).

Look beyond tech and property, though, and things are rather different. Many big private companies “have not only avoided regulatory assault but have also grown bigger”, says Huang Tianlei of PIIIE. Anta has built a global sportswear empire. Batteries made by CATL can be found in many of the world's EVs. Zhifei Biological, a maker of covid-19 and other tests from the central city of Chongqing, has come out of nowhere to land on the Fortune 500 list. Mr Zheng's firm, Jala, now employs 8,000 people and is one of the largest domestic makers of skincare products. His firm has become an important part of a cosmetics development park called “Oriental Beauty Valley”, where local brands have been encouraged to set up labs and hire scientists.

The bosses of these new corporate champions are dislodging tech moguls as owners of China's biggest fortunes, notes Rupert Hoogewerf of Hurun, a compiler of rich lists (see chart 2). China's wealthiest man is now Zhong Shanshan, who built Nongfu, which sells bottled water.

Many tycoons have greatly added to their personal wealth with direct help from local authorities. Take Muyuan, which has grown into one of the world's biggest hog producers. The Communist Party of Nanyang city,

where the company is based, has an explicit goal of putting it on the Fortune 500 list. In late 2021 the local party told officials to make land available for Muyuan, and to streamline its various applications and inspections. The company is to receive subsidies for farm equipment, and local engineers and other workers are to be connected with the company, the plan ordains. The fortune of Muyuan's founder, Qin Yinglin, has swollen to \$23bn.

As for the next generation of entrepreneurs, Mr Xi recently urged them to "dare to start a business". His message has been one of unwavering support for startups—as long as they focus on the areas the government has prioritised. These include cloud computing, green energy and high-end manufacturing. The central government wants to create 1m innovative small and medium-sized firms between 2021 and 2025. Of those, 100,000 will be dubbed "specialised new enterprises" and 10,000 will earn the distinction of "little giant". The state still takes direct stakes in private companies. But it is finding new ways to influence and guide the private sector, often through industrial parks and a system of state-designated status.

Firms are free not to participate, but many will find great benefits to becoming part of these ecosystems of talent, capital and market access. Designations such as "little giants" act as endorsements and signal where capital ought to flow. Such labels also make for "good public relations", says Gu Jie, founder of Fourier, a robotics startup. Obtaining them eases access to places like Zhangjiang Robotics Valley in Shanghai, part of a larger high-tech development zone housing 150 research and development (R&D) centres, more than 24,000 companies and 400,000 workers. The local government owns and runs the zone.

Startups benefit in other ways. Mr Gu, whose firm is based in Zhangjiang, notes that securing the metal components for Fourier's prototypes takes

weeks rather than months, because many of the suppliers themselves reside in the technology park. He has also been able to tap the local talent pool, hiring more than 600 engineers and scientists in the past few years. Doing that in Silicon Valley or other global tech hubs would be time-consuming and prohibitively expensive, Mr Gu observes.

Fourier has attracted money from SoftBank, a Japanese tech-investment group, and Aramco Ventures, the venture-capital arm of Saudi Arabia's oil colossus. It has also been backed by Chinese government funds. These state investments were smaller than SoftBank's. But they send a message to the market about Fourier's prospects. Such guidance funds, as they are called, are proliferating. Many are run by local governments. Other state entities have taken over the controlling rights to an average of 50 privately run listed firms each year over the past three years, up from six in 2017 and 18 in 2018, reckons Fitch, a rating agency (see chart 3).

| *Forward, guidance funds*

The recipients of such largesse do not see this as the first step to nationalisation. Zhou Hanyi, co-founder of Xinzailing, a company specialising in lift safety, likens it instead to a bank loan without a fixed maturity, which does not typically engender state meddling.

The state's goal in promoting guidance funds and schemes like "little giants" is to boost R&D and help train talent. If a particular company fails, its technology and workforce can be absorbed by others without too much waste, says Christopher Fong of Welkin Capital, a private-equity firm in Hong Kong (and investor in Xinzailing). Older businesses, too, are opting to join state-backed innovation parks. Mr Zheng, who built Jala with neither state help nor a party membership, has begun working with a district government in Shanghai.

All this hints that Mr Xi's ideal private sector might look something like

Germany's Mittelstand, according to Enodo Economics, a research firm: "a large stable of small private firms that are innovative, generate high-paying jobs and produce technologically advanced manufactured goods". Some entrepreneurs say bureaucracy is being cut back in professionally managed industrial zones and that the state is meddling less in their operations. Yet there are reasons for scepticism.

In practical terms, Mr Xi's pursuit of higher-quality growth is easier in some parts of the country than in others. The startup zones in Shanghai are well-tuned machines with professional staff. Some employ former Wall Street bankers. By contrast, an analyst who recently visited an industrial park in the southern province of Hunan recounts that it resembled a film set made to look like Hangzhou, a big tech hub and home to Alibaba, without any real innovation taking place.

When startups soak up local-government largesse, moreover, they tie themselves to the fate and interests of local officials. This has always been a risk for companies but is becoming a more pressing concern as local authorities' involvement in business becomes closer. Last year the local government in Hangzhou conducted a sweeping review of the holdings of 25,000 officials and their family members. The city's party chief, believed to have links to Alibaba, was put under investigation and expelled from the party.

Mr Xi's vision faces another, more fundamental challenge. As a recent report from the Institute on Global Conflict and Co-operation, a think-tank at the University of California, San Diego, puts it, the idea is ultimately for private firms to "cluster and fill in the rest of the supply chain" around the state sector. In other words, rather than compete in a marketplace for customers who are themselves subject to competitive pressures, private companies are increasingly expected to cater, directly or indirectly, to the state itself. Some may still try to dream up new products and services that

appeal to a wide audience. But if more entrepreneurs find cosyng up to government a surer road to commercial success, the private sector may lose some of its dynamism.

Deng and his successors understood the flaws of too much state control. Mr Xi seems intent on proving them wrong. As for the new tycoons, they will, like pragmatic bosses everywhere, adapt in order to prosper for as long as they can. ■



中国的私营企业

来会会中国的新一代大亨

习领导的经济中谁是赢家？

习近平对中国有一个总体规划。其最终目标是让中国成为21世纪具主导地位超级大国，既令人畏惧又受人钦佩。中国越来越多地耀武扬威，体现出想让世界畏惧的渴望。至于钦佩，那将来自不断增长的经济和科技实力。在这方面，习的计划涉及重塑中国的私营企业。

乍看之下，他的计划让企业很痛苦。对成功互联网公司的打击已致使它们的总市值蒸发了2万亿美元之多。8月4日，电子商务巨头阿里巴巴公布季度收入首次下滑。其金融子公司蚂蚁集团在前一天透露利润下滑。这两家公司的共同创始人马云可能很快就会放弃对蚂蚁的控制权。在过去两三年里，他的净资产缩水超过200亿美元。陷入困境的房地产巨头恒大的创始人许家印的净资产已从2020年的400亿美元暴跌至60亿美元。上个月，汽车制造商Stellantis（其最大股东Exor拥有本刊母公司部分股权）的老板卡洛斯·塔瓦雷斯（Carlos Tavares）抱怨“政治干预越来越多”，表示公司将从中国的一家合资公司退出。

但如果仔细看，就会发现实际情形要更复杂。在习领导的中国，一些企业日子难过，另一些却风生水起。金融信息公司彭博的数据显示，今年迄今，中国大陆的IPO筹集了创纪录的580亿美元，而美国仅为190亿美元，中国香港只有50亿美元。据报道，另有1000家公司在排队上市。一批新的大亨也在冒头。根据彭博的数据，自2020年初以来，中国前十大富豪积累了1670亿美元的净财富。本刊在过去几周里采访的几家新领军者流露出了出奇乐观的情绪。

本世纪，中国的私营部门已从一潭死水发展成为全球最具活力的私营部门之一。根据美国智库彼得森国际经济研究所（Peterson Institute for International Economics，简称PIIE）的数据，到2020年，私营控股公司占中国100家最大上市公司市值的一半以上，而十年前还不到十分之一。

私营部门雇用了五分之四的城镇工人，总计约1.5亿人。在按收入对全球最大公司排名的财富500强中有32家中国私营企业，而在2005年一家都还没有。

从毛泽东思想到市场经济的历程漫长而艰巨。在1992年之前，“企业家是让人看不起的”，当时在辽宁省一个政府部门任职的郑春颖回忆说。但那时的中国已是一片谈论变革之声，拖着病体的领导人邓小平刚刚重申了政府对经济改革的承诺。辽宁的地方政府开始鼓励干部和党员自己开办公司。郑春颖自豪地与妻子和妹妹一起开了一家小店，出售从香港进口的服装和从欧洲进口的鞋子。1996年干部经商突然遭禁，他并没有关掉自己的店，而是辞去了政府工作。

当时弃政从商的不止他一人。2002年党章作出修改，允许商人成为党员，证明了他的决定是正确的。此后，中国公司不断壮大。企业界称2012年至2017年这习领导下的头五年是私营企业的鼎盛时期。阿里巴巴和腾讯等科技集团以及海航和大连万达等企业集团在全球范围内声名鹊起。它们的创始人变得家喻户晓，也积累了巨额财富。

五年前氛围开始变化。首先是政府迅速出手整顿企业集团，其中一些随后破产（例如海航）或被国有化（如大型保险公司安邦）。然后成千上万私营影子银行被关停。过去两年里轮到了科技巨头，它们受到监管调查、罚款，并被施以从用户数据到员工待遇的各种严厉新规；还有房地产公司，它们借新债的能力开始受到政府限制。去年，私营部门在中国100家最大公司总市值中的占比首次下降（见图表1）。

不过，在科技和房地产业之外，情况就大不相同了。PIIE的黄天磊表示，许多大型私营企业“不仅躲过了监管冲击，生意还越做越大”。安踏打造了一个全球运动服饰帝国。全球许多电动汽车都装着宁德时代制造的电池。来自中部城市重庆的新冠肺炎和其他疾病检测试剂制造商智飞生物突然出现在了财富500强名单上。郑春颖的伽蓝集团现在雇有8000名员工，是国内最大的护肤品生产商之一。他的公司已成为号称“东方美谷”的化妆品研发园区的重要成员，这个园区鼓励本地品牌建立实验室并聘请科学家。

发布胡润富豪榜的胡润指出，这些新龙头企业的老板正在取代科技巨头成为中国顶尖富豪（见图表2）。现在中国的首富是农夫山泉的创始人钟睒睒。

许多大亨在地方政府的直接帮助下个人财富大涨。比如牧原，它已成长为世界上最大的生猪生产商之一。该公司总部所在的南阳市的党委有一个明确的目标，就是要让牧原登上财富500强榜单。2021年底，南阳党委要求官员为牧原提供土地，并简化各种申请和检查手续。党委的计划要求为牧原提供农业设备补贴，并在该公司和地方上的工程师及其他工人之间牵线搭桥。牧原创始人秦英林的身家已暴涨至230亿美元。

至于下一代企业家，习近年来敦促他们要“勇于创业”。他给出的信息是将坚定不移地支持创业公司，只要它们专注于政府列为优先级的领域，包括云计算、绿色能源和高端制造。中央政府希望在2021年至2025年期间培育100万家创新型中小企业。其中包括10万家“专精特新企业”，一万家“小巨人”企业。政府仍然直接持有私营公司的股份。但它正在寻找新的方式来影响和引导私营部门，通常是通过产业园区和一套由国家指定地位的制度。

企业可以不参与由政府引导的发展，但许多人将会发现加入这种人才、资本和市场准入生态系统能带来巨大的好处。诸如“小巨人”企业之类的称号有背书的作用，表明资本应该流向这些公司。机器人创业公司傅利叶智能的创始人顾捷说，这样的标签也有助获得“良好的公共关系”。拥有着这些称号可以更方便地与上海的张江机器人谷等场所连接，这个机器人谷是张江高科技园区的一部分，该园区有150个研发中心、2.4万多家公司和40万名员工。园区由当地政府所有并运营。

创业公司还能从其他方面受益。顾捷的公司位于张江，他指出，傅利叶的机器人原型所需的金属部件只要几周就能拿到，而不用几个月，因为许多供应商本身就在这个高科技园区内。他还可以利用本地的人才资源，在过去几年中雇用了600多名工程师和科学家。而在硅谷或其他全球科技中心做这件事会很耗时又非常昂贵，顾捷认为。

傅利叶智能吸引到了日本科技投资集团软银和石油巨头沙特阿美的风投部门Aramco Ventures的投资。它也受中国的政府基金支持。这些政府投资要少于软银，但向市场传达了有关傅利叶智能前景的信息。这种所谓的引导基金正在激增，许多由地方政府运作。评级机构惠誉（Fitch）估计，在过去三年中，其他国有实体平均每年接管了50家私营上市公司的控制权，高于2017年的6家和2018年的18家（见图表3）。

| 引导基金，向前向前

获得政府慷慨注资的公司并不认为这是国有化的第一步。专事电梯安全的公司新再灵的联合创始人周含奕将引导基金比作没有固定期限的银行贷款，这通常不会引来政府干预。

政府推动引导基金和“小巨人”等计划的目的是促进研发和人才培养。香港的私募股权公司汇勤集团（Welkin Capital，也是新再灵的投资方）的方健丰说，如果某家公司倒闭了，它的技术和员工可以被其他公司吸收，而不会造成太多浪费。老牌一点的企业也在选择加入政府支持的创新园区。郑春颖创建伽蓝的时候既没有国家帮助，本身也不是党员，他如今已经开始和上海的一个区政府合作。

在研究公司Enodo Economics看来，所有这些都暗示着习理想中的私营部门可能类似于德国的中小企业（Mittelstand），也就是“一大群具有创新精神、创造高薪岗位、生产技术先进的制成品的小型私营企业”。一些企业家表示，在专业管理的产业园区里，官僚主义在减弱，政府对他们运营的干预在减少。然而，有理由对此抱持怀疑态度。

在实践中，习对更高质量增长的追求在中国某些地区比在其他地区更容易推进。上海的创业园区是由专业人员操作的经精心调校的机器。有些还雇用了在华尔街工作过的银行家。相比之下，一位最近参观了湖南省一个产业园区的分析师回忆说，这个园区就像照着阿里巴巴所在的大型科技中心杭州搭起来的电影布景，却没有任何真正的创新在发生。

此外，一旦创业公司收下了地方政府的慷慨资助，就把自己与当地官员的

命运和利益绑在了一起。这从来都是企业面临的一个风险，但随着地方当局更密切地参与到企业运作中，这个问题变得更加紧迫了。去年，杭州地方政府对2.5万名官员及其家属与企业的关系展开一轮全面审查。被认为与阿里巴巴有关联的市党委书记受到调查并被开除了党籍。

习的愿景还面临着另一个更根本性的挑战。正如加州大学圣地亚哥分校的智库全球冲突与合作研究所（Global Conflict and Co-operation）最近的一份报告所说，习的想法是最终让私营企业围绕国有部门“聚集并填补供应链的其余部分”。换言之，私营公司越来越被期望直接或间接地迎合政府需要，而不是参与市场竞争以争取自身也承受竞争压力的客户。有些公司可能仍在尝试构想吸引广大受众的新产品和服务。但是，如果更多的企业家发现向政府靠拢是通向商业成功更可靠的道路，那么私营部门可能会丧失一些活力。

邓小平及其继任者深知政府控制过多的弊端。习似乎决意要证明他们错了。至于新晋大亨们，他们会像世界各地务实的老板一样，适应变化，以求把生意尽可能做长久。■



The Economist Film

Interest rates and central banks - Part 2

It may be a blunt instrument, but raising interest rates is still central banks' main tool for taming inflation.



经济学人视频

利率与央行（下）

加息可能是一件不那么好用的工具，但它仍然是央行驯服通胀的主要工具。



Interest rates

Ben Bernanke and Edward Chancellor square off on monetary policy

Their duelling books reveal the clashes between central bankers and their critics

The Price of Time. By Edward Chancellor. Atlantic Monthly Press; 416 pages; \$28. Allen Lane; £25

21st Century Monetary Policy. By Ben Bernanke. W.W. Norton; 512 pages; \$35 and £24.99

THERE IS A particular kind of critic of central banks who says that setting interest rates—and especially setting them low—is an unwarranted interference with the free market. In a system of paper (and electronic) currency, however, policymakers have no choice but to set what economists call a “nominal anchor”, a peg that determines the value of money. Decades of theory and evidence lie behind the modern approach of pegging interest rates with the ultimate goal of controlling inflation. Yet nominal anchors are inevitably somewhat arbitrary because paper money has no inherent value. The critics who label as artificial the low interest rates that have prevailed in the world economy in recent decades must therefore answer the question: low relative to what?

“The Price of Time” is the answer of Edward Chancellor, a historian and financier who has written a book by that name. Humans prefer jam today to jam tomorrow. Interest rates are the reward for deferring gratification, for renting out money that could have been spent today. When rates fall too low, grave consequences follow: financial instability, higher inequality and pain for savers. As he makes his case, Mr Chancellor’s panoptic survey of the history of interest, and what classical economists said about it, will not fail to dazzle. The argument, however, is seriously flawed.

To see why, look to “21st Century Monetary Policy” by Ben Bernanke, who led America’s Federal Reserve through the global financial crisis from 2006-14 (and a fool in Mr Chancellor’s narrative). His book is partly a historical account of the past half-century or so of policymaking at the Fed and partly a study of the effectiveness and desirability of unconventional monetary tools, such as quantitative easing, that have grown in importance after the crisis.

For the likes of Mr Bernanke, the ultimate determinant of interest rates is the global balance between savings and investment which, over time, exerts a magnetic pull on central bankers trying to hit inflation targets. Rates have been low in part because desired savings have risen as societies have aged. It was Mr Bernanke who, in 2005, suggested that a “global saving glut” might have been weighing on global rates.

Mr Bernanke’s framework is more compelling than Mr Chancellor’s, as low or even negative interest rates can co-exist with humanity’s natural short-termism. Suppose someone has a wage income of 100 in their working life and zero in retirement. Though they may not target a 50/50 split, they will save to avoid penury. Lots of people building up a nest-egg—even one that is small relative to their working incomes—creates an imbalance that can, as a result of market forces, push rates lower than their discount rates. “Justice is violated when lenders receive little or nothing,” Mr Chancellor writes. He might as well rage against a population pyramid.

Mr Bernanke dispenses with many of the criticisms of low rates with which Mr Chancellor is taken; what his account lacks in vivacity it makes up for with analytical clarity. For example, he gives short shrift to the idea that loose monetary policy prolongs the lives of “zombie companies” whose capital would otherwise be reallocated to more productive endeavours. If interest rates are low because desired saving exceeds available lucrative investment opportunities, then of course capital will flow to less profitable

ventures instead. Low rates do not tie up capital, but make things easier for entrepreneurs who wish to borrow. Such an argument might not have the lustre of references to intellectuals such as David Hume or Frédéric Bastiat, but it is coherent.

By contrast, “The Price of Time” reads like a jumbled collection of every criticism to have been levied at low interest rates. Mr Chancellor argues that low rates benefit financial interests, then laments that they damage bank profits. He says low rates hurt retirees by making annuities unaffordable, but also that they benefit the elderly at the expense of the young by pushing up property prices. It is not always clear whether he thinks low rates lead to too little investment, too much investment or investment in the wrong sorts of things.

Messrs Chancellor and Bernanke do agree that low rates increase financial risk-taking, for reasons that economists do not fully understand. In theory, low rates should make credit cheaper uniformly; in reality, the riskiest borrowers benefit the most. But whereas Mr Chancellor sees this as sufficient reason to raise interest rates even when the economy is weak, Mr Bernanke sees it as an issue that is too little understood to form the basis of a monetary policy. Should the Fed ever raise rates to try to contain financial excesses? “In principle, yes,” says Mr Bernanke. “But in practice, very cautiously and not very often.”

Hence there is an amusing contrast between the books’ assessments of loose monetary policy after the global financial crisis. Mr Chancellor blames it for almost any ill he can identify in the American and world economies. Mr Bernanke regrets not having stimulated more, given how much the economy subsequently undershot the Fed’s employment and inflation targets. Again, it is Mr Bernanke’s account that is more convincing—for the simple reason that critics of loose money in the 2010s repeatedly predicted severe instability that never came. It took the

pandemic to cause markets to crash in the spring of 2020.

Central banks' recent blunder has not been allowing excessive financial vulnerabilities to build. Their misstep has been a failure to control inflation. On this point, readers are likely to find Mr Bernanke's book unsatisfactory, probably because it was written before the extent of the problem became clear. Readers may scoff when he describes a "burst" of inflation troubling the economy, or labels Jerome Powell, today's Fed chair who has looked hapless as inflation has risen, a "consummate 21st-century central banker". Though the lengthy discussion of alternative forms of stimulus may prove relevant again later in the decade, it will seem academic while central banks are desperately raising interest rates to get price growth under control.

Still, at least today's central bankers now recognise the importance of inflation targets. Mr Chancellor would overturn their primacy in pursuit of amorphous goals. His worldview has much in common with the liquidationists of the 1930s who thought the Depression, in which America's unemployment rate reached nearly 25%, was a necessary purging of the economy. (At one point he argues the 1930s weren't so bad after all because productivity growth was high.) By all means enjoy his colourful challenge to conventional wisdom. But when the time comes to appoint a central banker, choose someone like Mr Bernanke. ■



利率

伯南克与钱斯勒就货币政策展开对垒

两人的论著针锋相对，显现了央行官员与其批评者之间的观点冲突【《时间的价格》、《21世纪货币政策》书评】

《时间的价格》，爱德华·钱斯勒著。大西洋月刊出版社，416页，28美元；Allen Lane出版社，25英镑。

《21世纪货币政策》，本·伯南克著。W.W.诺顿出版社，512页，35美元/24.99英镑。

有一类针对央行的批评认为设定利率、尤其是设定低利率，是对自由市场的无端干涉。然而，在一个纸质（以及电子）货币体系中，政策制定者别无选择，必须设定决定货币价值的基准点，经济学家称之为“名义锚”。把利率与控制通胀的最终目标挂钩这一现代做法有数十年的理论和实证做支撑。但因为纸币本身并无内在价值，名义锚难免带些任意专断。因此，那些认为近几十年来世界经济中盛行的低利率是人为造成的批评者必须回答一个问题：“低”是相对于什么而言？

历史学家、金融家爱德华·钱斯勒（Edward Chancellor）给出的答案是“时间的价格”——这也是他新著的书名（The Price of Time）。相比明天尝到果酱，人们更想今天就尝到果酱。利率是对延迟满足的奖励，奖赏人们出借本来可以在今天就用掉的钱。如果利率降得太低，就会有严重后果：金融不稳定，不平等加剧，储户受损。在论证时，钱斯勒对利率的历史及古典经济学家的利率观做了全景式的评述，定然会令人眩目。然而他的观点存在严重缺陷。

要了解原因，请看本·伯南克（Ben Bernanke）的《21世纪货币政策》（21st Century Monetary Policy），他在2006至2014年领导美联储度过了全球金融危机（在钱斯勒的叙述中是一个笨蛋）。他的这本书既回顾了美联储在过去约半个世纪里的政策制定，也研究了非常规货币工具（如

量化宽松) 的有效性及其可取性, 这些工具在金融危机后越发受重视。

伯南克这一派认为, 利率的最终决定因素是储蓄和投资之间的全球平衡, 这一平衡关系会在长时间里对试图达到通胀目标的央行官员施加拉力。利率一直处于低位, 原因之一是随着社会老龄化, 储蓄意愿上升。正是伯南克在2005年提出, “全球储蓄过剩”可能压低了全球利率。

伯南克的框架比钱斯勒的更具说服力, 因为低利率甚至负利率可以与人类短视的天性共存。假设某人整个职业生涯的工资收入为100, 退休后的收入为零。虽然他可能不会设定计划把这笔钱对半分, 但总会存下一些钱来避免退休后陷入困顿。大批人积谷防饥(即使相对于他们的工作收入来说是很小的一部分) 就会创造一种不平衡, 在市场力量的作用下, 有可能推动利率低于贴现率。“出借资金的人得利很少或毫无所得, 这有违公平。”钱斯勒写道。他倒不如把怒火撒给人口金字塔。

伯南克不像钱斯勒那样对低利率有诸多批评, 他的言辞不那么犀利, 但他的分析条理清晰。例如, 有观点认为宽松的货币政策令“僵尸公司”苟延残喘, 而这些公司的资本原本可以重新配置到更有成效的活动中, 伯南克对此不以为然。如果利率低是因为意愿储蓄超过了现有的可获利投资机会, 那么资本当然就会转而流向利润较低的项目。低利率并没有束缚资本, 而是让企业家更容易借到钱。这一论调也许没有大卫·休谟(David Hume)或弗雷德里克·巴斯夏(Frédéric Bastiat)等知识分子的名言加持, 但逻辑清晰连贯。

相比之下, 《时间的价格》读起来像是把各种对低利率的批评做了一锅乱炖。钱斯勒先指出低利率有利财务利益, 然后又哀叹它有损银行利润。他说低利率使养老金难以负担, 损害退休者的利益, 但又称它推高房地产价格, 使老年人获益, 年轻人受损。他究竟认为低利率是导致投资过少、过多, 还是投向错误对象? 答案不尽清晰。

钱斯勒和伯南克倒是一致认为低利率会增加金融冒险, 经济学家还不完全了解个中原因。理论上, 低利率应该使得信贷成本一致下降; 但现实中,

风险最大的借款人受益最大。在钱斯勒看来，这就是即使在经济疲软的情况下也要加息的充分理由，而伯南克则认为在这方面的了解还太少，无法以之作为制定货币政策的基础。美联储应否加息来遏制金融过度？“原则上，是的，”伯南克说，“但在实践上要非常谨慎，而且不能太频繁。”

所以，两本书对全球金融危机后宽松货币政策的评价形成了有趣的对比。钱斯勒把美国及世界经济中他能发现的几乎所有问题都归咎于宽松货币政策。伯南克则后悔刺激力度不够，因为后来美国经济的表现大大低于美联储的就业和通胀目标。同样，还是伯南克的说法更有说服力，原因很简单——2010年代宽松货币政策的批评者反复预言将出现严重不稳定，但从未发生。直到2020年春季新冠疫情的暴发才导致了市场崩溃。

各地央行近来的失误不在于坐视金融脆弱性过度积累，而在于未能控制通胀。在这一点上，读者很可能对伯南克的书不甚满意，大概因为此书是他在该问题的严重程度显现之前写就的。他描述“一阵子的”通胀困扰经济，还把面对通胀上升显得束手无策的现任美联储主席鲍威尔称为“完美的21世纪央行官员”，可能都会让读者嗤之以鼻。书中长篇大论地探讨其他类型的刺激措施，这在六七年后也许能派上用场，但在央行拼命提高利率以控制价格上涨之时，这些看起来只是空谈。

不过，至少央行官员们现在认识到了通胀目标的重要性。而钱斯勒会推翻它们的至高地位以追求不大确定的目标。他的世界观与上世纪30年代的清算主义者有很多共同点，他们认为大萧条（美国当时失业率接近25%）是美国经济必需的一场净化。钱斯勒在书中一度指出1930年代其实没那么糟糕，毕竟生产率增长很高。我们大可欣赏钱斯勒对传统观点发起的华丽挑战，但在任命央行官员时，还是请选择伯南克这样的人。■



Sustainable investing

ESG should be boiled down to one simple measure: emissions

Three letters that won't save the planet

If you are the type of person who is loth to invest in firms that pollute the planet, mistreat workers and stuff their boards with cronies, you will no doubt be aware of one of the hottest trends in finance: environmental, social and governance (ESG) investing. It is an attempt to make capitalism work better and deal with the grave threat posed by climate change. It has ballooned in recent years; the titans of investment management claim that more than a third of their assets, or \$35trn in total, are monitored through one ESG lens or another. It is on the lips of bosses and officials everywhere.

You might hope that big things would come from this. You would be wrong. Sadly those three letters have morphed into shorthand for hype and controversy. Right-wing American politicians blame a “climate cartel” for soaring prices at the petrol pump. Whistleblowers accuse the industry of “greenwashing” by deceiving its clients. Firms from Goldman Sachs to Deutsche Bank face regulatory probes. Although ESG is often well-meaning it is deeply flawed. It risks setting conflicting goals for firms, fleecing savers and distracting from the vital task of tackling climate change. It is an unholy mess that needs to be ruthlessly streamlined.

The term ESG dates as far back as 2004. The idea is that investors should evaluate firms based not just on their commercial performance but also on their environmental and social record and their governance, typically using numerical scores. Several forces have thrust it into the mainstream. More people want to invest in a way that aligns with their concerns about global warming and injustice. More companies, including a sister firm of The Economist, offer ESG analysis. With governments often gridlocked, many people feel business should solve society's problems and serve all

stakeholders, including suppliers and workers, not just shareholders. And then there is the self-interest of an asset-management industry never known to look a gift horse in the mouth: selling sustainability products allows it to charge more, easing a long blight of falling fees.

Unfortunately ESG suffers from three fundamental problems. First, because it lumps together a dizzying array of objectives, it provides no coherent guide for investors and firms to make the trade-offs that are inevitable in any society. Elon Musk of Tesla is a corporate-governance nightmare, but by popularising electric cars he is helping tackle climate change. Closing down a coalmining firm is good for the climate but awful for its suppliers and workers. Is it really possible to build vast numbers of wind farms quickly without damaging local ecology? By suggesting that these conflicts do not exist or can be easily resolved, ESG fosters delusion.

The industry's second problem is that it is not being straight about incentives. It claims that good behaviour is more lucrative for firms and investors. In fact, if you can stand the stigma, it is often very profitable for a business to externalise costs, such as pollution, onto society rather than bear them directly. As a result the link between virtue and financial outperformance is suspect. Finally ESG has a measurement problem: the various scoring systems have gaping inconsistencies and are easily gamed. Credit ratings have a 99% correlation across rating agencies. By contrast, ESG ratings tally little more than half the time. Firms can improve their ESG score by selling assets to a different owner who keeps running them just as before.

As investors become wiser to such flim-flam, they are growing more sceptical. This, coupled with turmoil in financial markets, is slowing the influx of money into sustainable funds. It is surely time, then, for a rethink. The first step is to unbundle those three letters: E, S and G. The more targets there are to hit, the less chance of bullseye-ing any of them. Regarding S, in

a dynamic, decentralised economy individual firms will make different decisions about their social conduct in the pursuit of long-run profits within the law. Tech firms may appeal to the values of young employees to retain them; firms in declining industries may have to lay people off. There is no one template. The art of management, or G, is too subtle to be captured by box-ticking. Britain's listed firms have an elaborate governance code—and dismal performance.

It is better to focus simply on the E. Yet even that is not precise enough. The environment is an all-encompassing term, including biodiversity, water scarcity and so on. By far the most significant danger is from emissions, particularly those generated by carbon-belching industries. Put simply, the E should stand not for environmental factors, but for emissions alone. Investors and regulators are already pushing to make disclosure by firms of their emissions more uniform and universal. The more standardised they are, the easier it will be to assess which companies are large carbon culprits—and which are doing most to reduce emissions. Fund managers and banks should be better able to track the carbon footprints of their portfolios and whether they shrink over time.

| *Unsustainable*

Better information alone will help in the struggle against global warming. By revealing more accurately which firms pollute, it will help the public understand what really makes a difference to the climate. A growing number of altruistic consumers and investors may choose to favour clean firms even if it costs them financially. And even if they can get away with polluting today, many firms and investors expect that tighter regulation of carbon emissions will eventually come and want to measure their risks and adapt their business models.

Make no mistake, though: tougher government action is essential now. We have long argued for much higher carbon prices that would harness the

market to save the planet. Today pricing schemes cover 23% of global emissions, about double the level of five years ago. But far more needs to be done, not least in America. It is government action, combined with clear and consistent disclosure, that can save the planet, not an abbreviation that is in danger of standing for exaggerated, superficial guff. ■



【首文】可持续投资

ESG应该浓缩成一个简单的衡量标准：排放

三个字母救不了地球

如果你是那种不愿意给污染地球、苛待员工、在董事会中安插亲信的公司投资的人，那你肯定了解金融领域最热门的趋势之一：环境、社会和治理（ESG）投资。这种投资试图改善资本主义的运作，并应对气候变化带来的严峻威胁。近年来，这部分投资急剧膨胀，投资管理巨头们称自己超过三分之一、总计35万亿美元的资产要经受ESG某一方面的监督。各地的老板和官员都把它挂在嘴边。

你可能会希望这会带来重大的改变。那你要失望了。这三个字母已经不幸演变成了炒作和争议的简称。美国右翼政客指责一个“气候卡特尔”导致了汽油价格飙升。吹哨人控诉投资行业欺骗客户的“漂绿”行为。从高盛到德意志银行的一众公司面临监管调查。尽管ESG的用意通常是好的，但存在严重缺陷。它可能引发各种风险，令企业设定相互冲突的目标、薅储户的羊毛、分散应对气候变化这一关键任务的注意力。这团危险的乱毛球需要下狠手厘清简化。

ESG一词可以追溯到2004年。按照这一观念，投资者在评估企业时不应仅依据其商业业绩，还要看它们在环境和社会方面的成绩以及治理水平，通常使用数字评分。几股力量将它推入了主流。越来越多的人希望能有一种投资方式契合自己对全球变暖和不公正的担忧。提供ESG分析的公司也增多了，本刊的姐妹公司就是其中一个。由于政府经常陷入僵局，许多人觉得应该由商界来解决社会问题，服务包括供应商和工人在内的所有利益相关者，而不仅仅是股东。这也符合资产管理行业的自身利益。对于送上门的生意，它向来不挑三拣四，而销售可持续产品能够让它收取更高的费用，缓解费用下降这一长期困扰。

遗憾的是，ESG存在三个根本性问题。首先，因为它将令人眼花缭乱的各色目标混杂在一起，无法提供始终如一的指导，来帮助投资者和企业去做

在任何社会中都不可避免的权衡取舍。特斯拉的马斯克是公司治理的噩梦，却在通过普及电动汽车帮助应对气候变化。关闭一家煤矿公司有益于气候，却会殃及它的供应商和工人。真的有可能在不破坏本地生态的情况下快速建造大量的风力发电场吗？ESG暗示这些冲突并不存在或者很容易解决，让人产生错觉。

该行业的第二个问题是在激励方面不够坦白透明。它声称良好的行为能让企业和投资者赚取更大利润。事实上，如果企业能忍受骂名，将成本（如污染）转嫁给社会而不是直接由自己承担往往非常有利可图。因此，德行和卓越财务表现之间的联系令人生疑。最后，ESG在衡量标准上也有问题：各种评分系统间的差异非常大，而且很容易被做手脚。不同评级机构的信用评级有99%的相关性，相比之下，不同ESG评级的相关性只勉强过半。企业可以通过将资产转手他人来提高ESG分数，即便新的所有者的经营方式并无不同。

随着投资者越来越能识破这种鬼把戏，他们的疑心也越来越重。再加上金融市场的动荡，资金流入可持续基金的速度正在放缓。那么，现在肯定是到了需要反思的时候了。第一步就是要把E、S和G这三个字母拆解开来。要达成的目标越多，命中任何一个靶心的机会就越小。就字母S而言，在一个活跃且去中心化的经济体中，单个企业会对自身社会行为做出不同的决策，在法律允许的范围内追求长期利润。科技公司可能会顺应年轻员工的价值观来留住他们，而衰退行业中的公司可能就不得不裁员了。这当中并没有一个可套用的模板。管理的艺术（也就是G）太过微妙，靠在表格上打钩无法捕捉。英国的上市公司有一套复杂精细的治理准则，业绩却惨不忍睹。

还是干脆只关注字母E为好。不过就连这样也还不够精准。环境是一个无所不包的词，包括生物多样性、水资源短缺等等。而最大的危险绝对来自排放，尤其是身为碳排放大户的行业造成的排放。简而言之，E不应该代表环境因素，而是应该只代表排放（emission）。投资者和监管者已经在推动企业更统一和普遍地披露它们的排放量。披露越标准化，就越容易评估哪些公司是碳排放的元凶，哪些在减排方面最尽心尽力。基金经理和银

行应该也能够更好地追踪其投资组合的碳足迹，以及它们的碳足迹是否逐步减少。

| 不可持续

单是提高信息质量就会有助对抗全球变暖。这能更准确地揭示哪些企业造成了污染，会帮助公众理解究竟是什么对气候产生了影响。利他主义的消费者和投资者越来越多，他们可能宁可多花钱也选择支持清洁的企业。就算许多造成了污染的公司和投资者今天躲过了追责，它们也可以想见更严格的碳排放监管终将到来，因而会想要衡量自身的风险并调整商业模式。

不过不要误会了。更强硬的政府行为在目前至关重要。我们早就主张大幅提高碳价，利用市场来拯救地球。今天，定价机制覆盖了全球23%的排放量，大约是五年前的两倍。但需要做的事远不止于此，尤其是在美国。唯有政府行动加上清晰一致的信息披露才能拯救地球，而不是指望一个可能变成代表夸大、肤浅和胡扯的缩写词。■



The latest railway bazaar

A new web of Arab railways could transform the Middle East

But old enmities block many of the links

Not since the Hijaz railway between Damascus and the holy city of Medina was ruptured by the British buccaneer-cum-scholar T.E. Lawrence in the first world war has overland travel out of Saudi Arabia's hinterland seemed so simple. On March 31st the first passenger train pulled out of Riyadh, the Saudi capital, and sped north past 1,215km (755 miles) of sand dunes to Qurayyat, a town near the Jordanian border. Within weeks the sleeper was proving so popular that your aggrieved correspondent's couchette was double-booked. "You'll get your bed in heaven, God willing," promised the train's conductor, ushering him into one of the few vacant overnight seats.

Colonial-era railway routes blocked or destroyed by conflict or disuse are being reconnected. From Marrakech in Morocco to Mashhad in Iran, governments are investing tens of billions of dollars expanding decayed networks. Some 25,000km of track today is expected to grow by tens of thousands of kilometres by 2040. Saudi Arabia is tripling its network. The region has two high-speed lines that whizz passengers at 300kph, with more being built.

The revival has long been delayed, in part for lack of regional integration. After the collapse of the Ottoman, British and French empires, independence severed the lines colonial powers had built to help rule vast swathes of land. Newly minted countries closed borders and blew up bridges. Israel's creation in 1948 drove a wedge between lines linking Asia to Africa.

What is more, most governments gave priority to private over public transport. "Everyone thought cars and trucks were enough," says a

spokesman for Israel Railways. Plans for an Arab Mashreq International Railway with a hub in Baghdad have come to nothing. The six countries of the Gulf Co-operation Council (GCC) paid only lip service to a railway project to link Kuwait along the Gulf to Oman.

But clogged roads, soaring populations and climate change are prompting a rethink. People need to move faster and more cleanly than along jammed, polluting roads, says the GCC's Abdel Aziz Aluwaisheg. Travelling on the proposed new line across the United Arab Emirates (UAE) from Abu Dhabi to Fujairah will take half the time of the car journey. Iran's high-speed line from Tehran to Isfahan will cut the trip from five hours to 90 minutes.

Demand is booming. Israel's passenger volume has soared from 12m two decades ago to 70m today and is projected to reach 400m by 2040. Egypt must upgrade its main lines, since passenger volume has risen 15-fold since the 1930s on track that is largely unchanged.

Metro systems are multiplying, too. Algiers, Dubai, Doha (Qatar's capital), Cairo and Tehran have expanded their systems. Riyadh's and Tel Aviv's should open next year. Cairo's new administrative capital will have north Africa's first monorail.

Tourists and pilgrims should benefit. Saudi Arabia's first high-speed train (pictured) runs between the holy cities of Mecca and Medina. Egypt has just signed a contract to build a fast track from Cairo along the Nile to the pharaonic statues at Abu Simbel, 1,100km away, near the border with Sudan. Morocco is planning a high-speed line to the tourist hub of Marrakech.

Trade should improve, too. Egypt's first high-speed train, set to open in 2027, will run from the Red Sea port of Ain Sukhna to Mersa Matruh on the Mediterranean, offering an alternative to the congested Suez canal. Saudi

Arabia is planning a speedy railway running from the port of Jeddah via Riyadh to the Gulf. The new line to Fujairah, on the Indian Ocean, will provide a means for freight leaving or entering the UAE to avoid the Strait of Hormuz, a strategic chokepoint at the entrance to the Gulf that Iran periodically threatens to close. Morocco hopes its high-speed train from Tangiers will one day zip along the coast through disputed Western Sahara to markets in west Africa. Even an undersea tunnel to Spain has been mooted.

China, a world leader in high-speed trains, wants to link Asia to Europe overland through the Middle East to foster its Belt and Road initiative. It has discussed such plans with Iran, Israel and the UAE. But Siemens, a German company, has outbid Chinese rivals to build Egypt's high-speed tracks. Morocco has signed up a French company, Saudi Arabia a Spanish one and Israel a German one for their high-speed projects. Most of the UAE's line has gone to a consortium of British and German companies.

Not all are aboard. Iraq, Palestine, Lebanon, Libya, Sudan, Syria and Yemen are too poor, war-torn or dysfunctional to restore their old tracks. State-owned airlines are lobbying to keep their lucrative short-haul routes. Old fears still make some governments twitchy. Oman, always wary of entanglements, has held back. Kuwait, wary of invasion, is nervous about linking up with Iraq. Qatar had once planned to build high-speed lines to Bahrain and Riyadh in time for this year's football World Cup. But it put on the brakes after its neighbours blockaded it for political reasons.

The fact that most of the new lines stop tantalisingly short of their frontiers illustrates this underlying queasiness. Israel's "peace line" ends 8km short of the border with Jordan. The new Saudi line north from Riyadh peters out 28km from the crossing into Jordan, which is wary of being part of a direct link from Mecca to Israeli-occupied East Jerusalem. Though Morocco has built a gleaming new station at Oujda, the old border crossing with Algeria,

the link between the two countries remains firmly shut. And China's dream of reaching the Levant is blocked by a missing link, 22km long, between Iran and Iraq. For all the talk of regional integration and new silk routes, the Middle East's railway map is still holed by the moths of history. ■



最新的铁路大巴扎

一个新的阿拉伯铁路网可能会改变中东的形态

但旧时的敌意封住了许多连接路段

自英国探险家兼学者T.E.劳伦斯（T.E. Lawrence）在一战中破坏了大马士革和圣城麦地那之间的汉志（Hijaz）铁路以来，通过陆路驶离沙特阿拉伯腹地似乎从未像现在这样简单。3月31日，第一列客运列车驶出沙特首都利雅得向北飞驰，经过绵延1215公里的沙丘，到达靠近约旦边境的城镇古赖亚特（Qurayyat）。几周下来，卧铺十分紧俏，以致倒霉的笔者的卧铺被重复预订了。“真主保佑，你的卧铺在天堂等着你呢。”列车员打包票说，带笔者在所剩无几的坐席找了个空位凑合一夜。

殖民时代的铁路线因战事或停运而被封锁或毁坏，如今正被重新连接起来。从摩洛哥的马拉喀什到伊朗的马什哈德，各地政府正在投资数百亿美元扩充破破烂烂的铁路网。今天总长约2.5万公里的铁轨预计到2040年将增加数万公里。沙特阿拉伯正在将其网络扩增两倍。该地区有两条时速300公里的高速铁路，还有更多条正在建设中。

这场复兴拖延了许久，部分原因是地区一体化不足。奥斯曼帝国、大英帝国和法兰西帝国崩溃后，殖民地相继独立，切断了殖民列强为协助统治大片土地而修建的铁路线。一个个新成立的国家关闭边境，炸毁桥梁。1948年以色列建国，给连接亚洲和非洲的线路打了个死结。

此外，大多数政府都优先发展私人交通而不是公共交通。“之前所有人都觉得有汽车和卡车就足够了。”以色列铁路（Israel Railways）的一名发言人说。以巴格达为枢纽修建阿拉伯马什里克国际铁路（Arab Mashreq International Railway）的计划已经落空。一个铁路项目计划沿波斯湾连接科威特和阿曼，但只得到了海湾阿拉伯国家合作委员会（GCC，简称海合会）六个成员国口头上的支持。

但道路拥堵、人口激增和气候变化正促使人们转变想法。海合会的阿卜杜

勒·阿齐兹·阿卢韦谢杰（Abdel Aziz Aluwaisheg）说，人们需要更快、更清洁的交通，而不是拥挤、污染严重的道路。从阿布扎比到富查伊拉（Fujairah），乘坐拟建的横跨阿联酋的新铁路线将比汽车旅行节省一半的时间。伊朗从德黑兰到伊斯法罕（Isfahan）的高速铁路将把旅程从五个小时缩短到90分钟。

需求在激增。以色列的客运量已经从20年前的1200万飙升至如今的7000万，预计到2040年将达到4亿。埃及必须升级它的主要线路，因为自20世纪30年代以来其铁路客运量已经增长了15倍，但铁路里程基本上没有变化。

地铁系统也在成倍增长。阿尔及尔、迪拜、多哈（卡塔尔首都）、开罗和德黑兰已经扩大了自己的地铁系统。利雅得和特拉维夫的地铁应该会在明年启用。开罗的新行政首都将拥有北非第一条单轨铁路。

游客和朝圣者应该会受益。沙特的第一列高速列车（如图）在麦加和麦地两座圣城之间运行。埃及刚刚签署了一份合同，从开罗沿尼罗河修建一条快速线路，通往1100公里外靠近苏丹边境的阿布辛贝神殿的法老雕像。摩洛哥正在规划一条通往旅游中心马拉喀什的高速铁路。

贸易应该也会随之改善。埃及首条高速铁路将于2027年开通，连接红海港口艾因苏赫纳（Ain Sukhna）和地中海的马特鲁港（Mersa Matruh），在拥堵的苏伊士运河之外提供另一种选择。沙特正在规划一条从吉达港（Jeddah）经由利雅得通往海湾的高速铁路。通往印度洋沿岸富查伊拉的新线路将为进出阿联酋的货物提供一条途径来绕开霍尔木兹海峡。这条海峡是波斯湾入口的一个战略咽喉要道，伊朗不时威胁要关闭它。摩洛哥希望其从丹吉尔（Tangiers）出发的高速列车有朝一日能够沿着海岸穿过有争议的西撒哈拉，到达西非的市场。甚至一条通往西班牙的海底隧道也已提出供讨论。

高铁领域的世界领军者中国希望能经由中东陆路将亚洲和欧洲连接起来，以促进其“一带一路”倡议。它已经与伊朗、以色列和阿联酋商讨了此类计

划。但是德国公司西门子在建造埃及高铁的竞标中击败了中国对手。摩洛哥与一家法国公司、沙特阿拉伯与一家西班牙公司、以色列与一家德国公司分别签订了高铁项目。一个由英国和德国公司组成的财团拿下了阿联酋的大部分线路项目。

并非所有人都欣然入伙。伊拉克、巴勒斯坦、黎巴嫩、利比亚、苏丹、叙利亚和也门因为太穷、饱受战争蹂躏或运作失灵，无力修复本国的旧铁路。国有航空公司正在大力游说以求保住自己利润丰厚的短途航线。旧时的担忧仍旧让一些政府焦虑不安。向来对纠缠不清心存警惕的阿曼已经退缩。科威特担心被入侵，对与伊拉克建立联系感到紧张。卡塔尔曾计划为今年的世界杯足球赛修建通往巴林和利雅得的高速铁路，但在邻国出于政治原因对其实施封锁后踩下了刹车。

事实上，大部分新线路还没修到边境就戛然而止，透露了各国心底的惴惴不安。以色列的“和平铁路”止于距约旦边境8公里处。沙特的新线路从利雅得向北延伸，到距离约旦边界过境处28公里处停止。约旦很不放心参与直接连接麦加到以色列占领的东耶路撒冷的铁路项目。尽管摩洛哥在与阿尔及利亚接壤的老边境口岸乌季达（Oujda）修建了一个锃光瓦亮的新车站，但连接两国的线路仍紧紧封闭。中国抵达黎凡特的梦想也被伊朗和伊拉克之间缺失的22公里长的路段所阻挡。尽管人们都在大谈地区一体化和新丝绸之路，但中东的铁路地图还是被历史的蛀虫咬得千疮百孔。■



The obesity gap

Why women are fatter than men in the Arab world

Society does not make it easy to shed pounds

ZEINAB, A MATRONLY 60-year-old in a black abaya, washes vegetables in a restaurant in Baghdad, taking home 20,000 dirhams (\$13.70) a day. But she cannot afford to buy her family a decent dinner. Her daughters dropped out of school because the fees were too high. Zeinab gets by because her boss gives her leftovers—mostly oily food, she says—from the restaurant. Thursday is the only day of the week she and her daughters eat fruit, since that is when people in her neighbourhood give away food for charity. Zeinab weighs 120kg.

Though grown up, none of her four daughters works. They are likely to become fat, too. Zeinab would rather be strapped for cash than risk men harassing them at work. So they sit at home, doing chores, occasionally visiting their extended family. Zeinab sometimes takes them out for an ice cream or to visit a holy shrine. “It’s not like they’re in prison—they’ve got phones and the internet,” she says defensively.

Across the world, more women than men are fat. Obesity is a problem for 15% of women and 11% of men, meaning that they have a body mass index (BMI) of 30 or higher. But the obesity gap varies across the world. The Middle East and north Africa has the biggest and most consistent disparity between the sexes. (Several countries in southern Africa have big gaps, too.) In the Middle East 26% of women are obese versus 16% of men. This can be dangerous. In 2019, eight Arab countries were among the 11 with the highest share of deaths attributed to obesity (mostly due to heart disease, diabetes and high blood pressure).

Only a fifth of women in Arab countries have paid jobs, says the World

Bank. In Iraq the share is one in ten. This means that most Arab women spend most of the day indoors, missing out on passive exercise. Working women in other regions bustle around in hospitals, classrooms and restaurants. But in Arab countries many such jobs are done mainly by men. In Gulf countries many of the heavier menial household chores are done by foreigners.

Moreover, women in Arab countries have fewer chances to enjoy sport. Young girls and boys play football together in the street. But once a girl reaches puberty, roughhousing in public is frowned upon. Teenage girls become more sedentary, meeting friends indoors. "We don't like girls to be outside," says a sweaty Iraqi man who plays football outdoors four times a week but does not let his sister follow suit. She has a treadmill at home, he says.

In any case, headscarves and clothes that cover the female body make public exercise cumbersome. Harassment in the street often makes jogging unpleasant. "When I walk my dogs, I have to put on music to block out the catcalls," says an Iraqi woman. Strolling tends to be in air-conditioned malls. Some gyms cater just to women, but are found mainly in big cities.

In Egypt poor women are on average fatter than rich ones. Rich families tend to be more relaxed about letting their daughters out. Still, Egypt has the highest women's BMI of any country in the world, bar some of the Pacific islands. Diet bears much of the blame. Egyptians get 30% of their calories from bread, much of it subsidised: the price of a kilo is fixed at \$0.61. Since 1975 Arab women have grown fatter at a quicker rate than Arab men, while junk food has steadily proliferated.

Wafa al-Khatib, a housewife in Baghdad, wants to slim down, so she asked her mother to do more of the cooking to help her resist culinary temptation. "Iraqis' problem is carbohydrates," she says. Her family eats

rice and bread at nearly every meal.

A final cause of obesity, according to some women, is that many Arab men prefer them to be Rubens-esque. Shutting women up at home helps keep them that way. Shireen Rashid, another Iraqi housewife, wants to shed a few pounds. But not too many. When you are skinny, “you lose your femininity”, she says. Her husband does not want her to lose weight at all. He fears she will “feel like a piece of wood in bed”. Iraqis often cite Enas Taleb, an actress with ample curves (pictured), as the ideal of beauty. Some claim Iraqi women even take weight-gaining pills to be more attractive to men. Alas, in the Arab world or indeed anywhere else, that is hardly the road to good health, let alone happiness. ■



肥胖鸿沟

为什么阿拉伯世界的女人比男人胖

社会让她们的瘦身难上加难

扎伊纳布（Zeinab）是个60岁的老妇人，穿着黑色长袍，在巴格达的一家餐馆洗菜，每天能挣2万迪拉姆（13.7美元）。但是她没钱让家人吃上一顿像样的晚餐。她的女儿因为学费太贵辍学了。扎伊纳布日子还过得去，因为老板会把餐馆的剩菜给她——大部分都是油腻的食物，她说。周四是她和女儿们一周中唯一有水果吃的日子，因为那天她家附近的人会做慈善分发食物。扎伊纳布体重240斤。

虽然她的四个女儿已成年，但都不工作。她们很可能也会肥胖。扎伊纳布宁可手头拮据，也不愿意冒让她们去上班被男人骚扰的风险。所以她们待在家里，做做家务，偶尔拜访一下大家庭里的亲戚。扎伊纳布有时会带她们出去吃冰淇淋或参观圣地。“她们又不是在蹲监狱——不是还有电话和互联网嘛。”她语带防卫。

全世界范围内，肥胖的女性比男性多。15%的女性和11%的男性患有肥胖症，也就是说他们的身体质量指数（BMI指数）达到30或更高。但是这种性别上的肥胖差异在世界各地程度不同。中东和北非的性别差异最大，也最顽固。（南部非洲的几个国家也存在很大差异。）在中东，26%的女性肥胖，而男性为16%。肥胖可能带来生命危险。2019年，肥胖症导致死亡（主要是由于心脏病、糖尿病和高血压）比例最高的11个国家中有八个是阿拉伯国家。

世界银行称，阿拉伯国家只有五分之一的从事有偿工作。在伊拉克，这一比例是十分之一。这意味着大多数阿拉伯妇女一天中大部分时间都待在室内，错失了被动运动的机会。其他地区的职业女性在医院、教室和餐馆里忙碌着，但在阿拉伯国家，许多这样的工作主要是由男性完成。在海湾国家，许多更繁重的家务粗活都是外国人来做的。

此外，阿拉伯国家的妇女享受体育运动的机会更少。小女孩和男孩们一起在街上踢足球。但是一旦女孩进入青春期，在公共场合玩闹就不受赞同了。十几岁的女孩变得更安静，见朋友也都是在室内。“我们不喜欢女孩去外面。”一名大汗淋漓的伊拉克男子说。他每周在户外踢四次足球，但不让他的妹妹也这样做。他说，她可以用家里的跑步机。

不论如何，女性得用头巾和衣服遮盖身体也使得她们在公共场合锻炼很不便。街上的骚扰常常使慢跑变得不愉快。“我遛狗的时候得放音乐来盖住嘘声。”一名伊拉克妇女说。闲逛往往也是在有空调的商场。倒是也有只面向女性的健身房，但一般都开在大城市里。

在埃及，贫困女性平均比富裕女性更胖。富裕家庭对于让女儿外出态度往往更放松。尽管如此，除了一些太平洋岛国之外，埃及女性的BMI指数是世界上最高的。这主要得怪饮食。埃及人30%的热量靠面包获得。大部分面包都有补贴，一公斤的价格固定在0.61美元。自1975年以来，阿拉伯妇女变胖的速度比阿拉伯男性更快，在此期间垃圾食品不断激增。

巴格达的家庭主妇瓦法·哈提卜（Wafa al-Khatib）想要瘦下来，于是拜托母亲多下厨，帮助自己抵抗美食的诱惑。“伊拉克人的问题是碳水化合物。”她说。她的家人几乎每餐都吃米饭和面包。

根据一些女性的说法，肥胖的最后一个原因是许多阿拉伯男性更喜欢她们像鲁本斯的画中人。把女人们关在家里有助于让她们保持那种体态。另一名伊拉克家庭主妇希琳·拉希德（Shireen Rashid）想减掉几磅，但也不要减太多。她说，如果你太瘦，“你就失去了女性魅力”。她的丈夫不想她减一丁点儿，担心她会“在床上触碰起来像块木头”。伊拉克人经常将拥有丰满曲线的女演员伊纳斯·塔勒布（Enas Taleb，如图）夸赞为美的典范。一些人声称伊拉克妇女甚至服用增肥药丸来吸引男人。唉，在阿拉伯世界里——或其他任何地方，这可不是通往健康之路，更别说幸福了。■



Menstruation and sport

How menstruation affects athletic prowess is poorly understood

Changing that will give sportswomen a new way to improve performance

Just 0.63 seconds separated first from fourth place in the women's 100 metres freestyle at the recent Tokyo Olympic Games—a race where the winning time was 51.96 seconds. In light of this and similar facts, it is not surprising that elite athletes are constantly searching for ways to get even 1% better. To that end, they hire strength coaches, nutritionists and sports psychologists. And lately, some female athletes have been trying a new tack: working with menstrual-cycle coaches.

Good data concerning the effects of menstruation on athletic performance are scant. However, according to four studies conducted in 2020 on more than 250 athletes from a range of sports, more than half of sportswomen believe their performance fluctuates with the phase of their menstrual cycle. In particular, many said they suffered in the weeks immediately before and during menstruation. World-class performers like Fu Yuanhui, a Chinese swimmer, have spoken openly about this, too. And female athletes also report distraction and worry about bleeding while actively menstruating, a matter which made the news recently when a group of activists protested about the all-white dress code at the Wimbledon tennis championships.

There is, as well, the question of safety. Again, this is poorly researched. An exception, though, is damage to the anterior cruciate ligament (ACL) of the knee. Women are much more prone to ACL injuries than men and some studies suggest the level of risk is related to the menstrual cycle.

Given the wide physiological effects of that cycle, the neglect of its consequences for sport is stark. The intricate monthly tango of oestrogen

and progesterone, the main hormones which regulate it, has consequences far beyond preparing the body to reproduce. The complexity of this dance, compared with the hormonal stability of men, is one reason for that neglect. But others are that sport is studied largely by male researchers, and male sport is currently more prominent and better paid.

| *A dance to the music of time*

The menstrual dance is, indeed, complex. For a start, oestrogen is anabolic, building up muscle, while progesterone is catabolic, breaking it down. Then, at the beginning of the cycle, body cells prefer to metabolise carbohydrates. Later on, they prefer fats. During the luteal phase, immediately after ovulation, when both hormones are high, the body is less resilient to stress and more prone to inflammation.

At this point women have increased appetites, higher internal temperatures, higher resting heart rates and higher respiratory drive. They also retain water and salt, causing them to put on weight. Their heat tolerance is reduced, too. And their moods and emotional regulation suffer. Here, then, is fertile ground for quite a few of those percentage-point improvements. And that is where menstrual-cycle-savvy coaches come in.

One possible tactic is phase-based training, in which a coach adjusts the intensity, volume and type of an athlete's workouts based on where she is in her cycle. Stacy Sims, a researcher at Auckland University of Technology, in New Zealand, recommends athletes increase intensity in the low-hormone follicular phase of the cycle, when the body is primed to bear heavy loads. Later, during the luteal phase, when bodies are less able to adapt to stress, she recommends focusing on steady-state aerobic training to allow proper bodily recovery. This pattern of training, she believes, allows female athletes to push themselves in the most efficient manner.

Such a one-size-fits-all approach may, though, be overly simple. Kirsty

Elliott-Sale, a professor at Manchester Metropolitan University, in Britain, thinks there is, as yet, no conclusive scientific evidence to back phase-based training. However, while wary of general guidelines, Dr Elliott-Sale sees the merits of an individualised approach which takes account both of monthly variation within an individual and inter-individual variability.

This latter source of variety may also help explain why conclusive population-level scientific evidence is hard to come by. A regular cycle can last between 21 and 40 days, and the hormonal details—how fast concentrations change, when they peak and how high they peak—vary. Also, different women experience different sensitivities to hormonal changes. Some have no symptoms. For others, the effects may include debilitating cramps, bloating, migraines and depression.

Maddy Cope, a professional climber and coach in Britain, emphasises the need to bridge the gap between where research stands and how athletes feel. She notes, for example, that most research does not translate well to her own discipline.

Climbing is a supremely technical matter, and the tests used in research compare poorly with the actual demands of the sport. Even here, though, a little menstruation-driven thinking may help. Most good training plans for climbers include exercises of a range of intensities and incorporate a “de-load” week, to allow the body to recover. Menstrual-cycle-informed training in this case might be as simple as arranging for the de-load week to coincide with the stress-sensitive luteal phase.

Menstrual-cycle coaching is, then, in its infancy. But, as women’s sports jostle more and more with men’s for the limelight, and the sums of money involved increase, many more athletes are giving it a go. In this and other areas, female sports-science is a promising field of research, as the fiction that men are the baseline and women an anomaly—a rib, as it were, pulled

from the chest of research on men—is put to rest. In sport, as in other areas, it is time for women to unlock their full potential. Period. ■



经期和运动

生理期对运动表现的影响尚不明确

改变这一点将给女运动员开辟提升表现的新途径【新知】

在去年的东京奥运会女子100米自由泳比赛中，第一名的成绩为51.96秒，第四名与冠军仅0.63秒之差。由于如此微小的差距屡见不鲜，顶级运动员不断寻找哪怕能将成绩提高1%的方法也就不足为奇了。为此，他们聘请了体能教练、营养师和运动心理学家。最近，一些女运动员还在尝试一种新的策略——与月经周期教练合作。

关于月经对运动表现影响的有用数据很少。然而，2020年对250多名从事各项运动的女运动员的四项研究表明，超过一半的人认为她们的运动表现会随月经周期而波动。尤其是许多运动员说她们在月经前一周和当周表现受影响。像中国游泳运动员傅园慧这样的世界顶级选手也公开谈到了“例假”对成绩的影响。女运动员还说，在月经期间比赛会因担心出血而分心。为此最近有一群活动人士抗议温布尔登网球锦标赛的全白着装要求，登上新闻。

还有安全问题，相关研究同样很少。不过有一个例外，即月经对膝盖前交叉韧带的损伤的影响。女性前交叉韧带的损伤率高于男性，一些研究表明风险水平与月经周期相关。

鉴于月经周期有广泛的生理影响，它对运动成绩的影响被忽视就显得很扎眼。调节月经周期的两种主要激素雌激素和黄体酮每月都有一次复杂难解的共舞，其影响远不止于让身体为繁殖做好准备。与男性稳定的荷尔蒙相比，这种共舞的复杂性是造成人们忽视月经周期的原因之一。但还有其他原因，比如运动科学的研究人员主要为男性，还有男子运动项目目前更受关注、报酬也更高。

| 随时间之乐起舞

月经之舞着实复杂。首先，雌激素促进合成代谢，可以促进肌肉生长，而

黄体酮促进分解代谢，会分解肌肉。然后，在月经周期的开端，身体细胞更喜欢代谢碳水化合物，往后则更喜欢代谢脂肪。在刚排卵后的黄体期，两种激素的水平都很高，身体更不耐受压力，更容易发炎。

此时女性食欲增加，体内温度升高，静息心率加快，呼吸驱动力加强。她们的身体还会保留水分和盐分，体重因而上升。她们的耐热力也降低了。心情和情绪调节折损。因此，这个阶段是将成绩提高几个百分点的绝佳时机，是精通月经周期的教练的用武之地。

一种可能的策略是分阶段训练，也就是教练根据运动员所处的月经周期阶段调整她受训的强度、量和类型。新西兰奥克兰理工大学（Auckland University of Technology）的研究人员斯泰西·斯姆斯（Stacy Sims）建议运动员在激素水平较低的卵泡期增加强度，此时身体已准备好承受重负。之后是压力耐受力下降的黄体期，她建议运动员在此时专注于恒速有氧训练，让身体适当恢复。她认为，这种训练模式可以让女运动员以最有效的方式提升自己。

不过这种一刀切的方法可能过于简单了。英国的曼彻斯特城市大学（Manchester Metropolitan University）的教授科斯蒂·艾略特-萨尔（Kirsty Elliott-Sale）认为，目前还没有确凿的科学证据支持这种分阶段训练法。尽管对这方面的普遍指导原则持谨慎态度，但艾略特-萨尔认为个性化的处理有其价值，也就是同时考虑个体体内一个月中的变化和个体之间的差异。

个体间差异可能也有助于解释为什么难以获得确凿的群体科学证据。一个正常的月经周期持续时间从21到40天不等，而荷尔蒙的具体变化——包括浓度变化的速度、达到峰值的时间以及峰值的高度——也因人而异。此外，不同女性对荷尔蒙变化的敏感程度也不同。有些人没有任何表现，而有些人则可能会出现痉挛无力、腹胀、偏头痛和抑郁等症状。

英国的专业登山者、教练马蒂·科普（Maddy Cope）强调需要弥合研究发现与运动员感受之间的差距。例如她指出，大多数研究结果并不能很好

地应用到她自己的运动项目中。

攀登是技术含量很高的运动，研究中用到的测试与这项运动对身体的实际要求相去甚远。不过即使这样，多少考虑一些月经周期的影响也可能有所帮助。大多数适合攀岩者的训练计划包括各种不同强度的内容，还有一个让身体恢复的“减负”周。在这种情况下，根据月经周期调整训练安排可能就很简单——把减负周安排在对压力敏感的黄体期就好。

总之，基于月经周期的训练还处于起步阶段。但是，如今女子运动越来越多地与男子运动争夺关注度，投入的资金也不断增加，开始尝试这类训练的运动员大幅增加。随着“男性是基准，女性是异常”的谬论（就等同于说女人是从男人的胸腔研究库中抽出来的一根肋骨）驱散，在这项研究以及其他环节，女性运动科学已成为很有前途的研究方向。和在其他领域一样，现在到了女性在体育上充分释放潜力的时间了。没错了！ ■



Nudge factor

Evidence for behavioural interventions looks increasingly shaky

The academic literature is plagued by publication bias

WHEN ECONOMISTS at the University of Toronto started to tell undergraduates in 2014 how many hours extra work they needed to put in to boost their grades, they hoped it would encourage the students to work harder. They didn't. Instead the students just began to expect the lower grades they received.

The university's experience is frequently quoted as an example of "nudge" theory backfiring. Nudge, the fashionable face of behavioural economics that launched a thousand light-touch government policies, has soared in popularity since the 2008 book of the same name by Richard Thaler, an economist, and Cass Sunstein, a legal scholar.

There are now more than 200 "nudge" units around the world, teams that specialise in applying behavioural science to everyday life. Nudges seek to persuade rather than compel behaviour change, through a series of psychological strategies, from presenting information in a different way to offering alternatives. As Mr Thaler and Mr Sunstein put it: "Putting fruit at eye level counts as a nudge. Banning junk food does not."

Nudge theory did not have a great pandemic. Nudge-friendly behavioural scientists were blamed by some for the British government's initial embrace of soft messaging—appeals to personal responsibility such as the slogan "stay home, save lives"—over strict measures including lockdowns, while a scheme using lotteries with prizes up to \$50,000 did little to boost vaccination uptake in Philadelphia.

Nudge fans received some better news at the end of 2021. The first attempt

to pool and judge the academic foundations of the theory, more formally known in the field as choice architecture interventions, reported in glowing terms. Psychologists at the University of Geneva analysed some 200 nudge studies and concluded that not only did nudges work overall, but that they did so impressively.

Behavioural scientists judge effect size with a measure called “Cohen’s d ”, which shows the difference between the average results in a control and treatment group. A score of zero means that the nudge has made no difference, while anything over 0.8 is considered to indicate a very large effect. The Geneva team said that nudge measures promoted behaviour change with an overall Cohen’s d of 0.43. That places it firmly in the medium-sized category and is more than enough to make most policymakers sit up and take notice.

Other psychologists saw the claims too, and many were unhappy with them. Last month, three separate academic groups, from Britain, Hungary and America, published critiques in the Proceedings of the National Academy of Sciences, which also published the Swiss team’s initial analysis.

The complainants make two similar points. First, the academic trials take such different approaches and report such wildly different effect sizes that it does not make sense to bundle them together in the same analysis. A “medium-sized” effect for nudges overall grossly exaggerates the impact of those that are useless and underestimates the benefits of those that work.

Second, nudge research is highly susceptible to publication bias—academic journals tend to favour publishing studies that report the largest effect sizes. After using statistical tools to account for the distorting effect of publication bias, the critics point out that the average effect size from the original analysis collapses, to as low as 0.04, which is effectively useless.

That does not mean that all nudges are ineffective, says Barnabas Szaszi, a psychologist at the University of Budapest and one of the critics. Famously, images of everything from flies to golf flags placed in urinals have been shown to improve men's aim and reduce cleaning costs. But in such a heterogeneous meta-analysis, those trials of nudge policies that do show significant effects are essentially swamped by the mass of those that don't. Such meta-analyses, says Mr Szaszi, should break down nudges into smaller distinct groups by type. Only then will policymakers have better ways to measure the effectiveness of different nudge tactics and so learn lessons from the best ones.

"We agree with most of the points raised," says Ulf Hahnel, one of the Geneva group that carried out the original meta-analysis in 2021. That work did not intend to portray nudges as a silver bullet, he says, and did include caveats about heterogeneity and publication bias.

The controversy emphasises that psychologists and other social scientists need to do more to combat publication bias, the critics say. One ongoing effort asks researchers to pre-register studies before they start, and for journals to agree to publish the results however they fall. Take-up is patchy. Time for a nudge? ■



助推因子

行为干预越来越不令人信服

相关学术文献深受发表偏差困扰

多伦多大学的经济学家从2014年开始告诉本科生若想提高成绩需要额外投入多少时间，希望鼓励学生更努力学习。学生并没有照做。相反，他们开始只求拿到过得去的成绩。

多伦多大学的这个故事常被引为“助推”理论的反例。自从经济学家理查德·塞勒（Richard Thaler）和法学家卡斯·桑斯坦（Cass Sunstein）在2008年出版《助推》（Nudge）一书以来，作为行为经济学中的时髦理论，助推理论催生了上千种低干预政府政策，热度大增。

现在全球有200多个“助推”小组，专门把行为科学应用到日常生活中。助推理论试图通过一系列心理学策略（包括改变信息呈现的方式或者提供替代选择）来说服而非强迫人们改变行为。正如塞勒和桑斯坦所说的：“把水果放到人们眼面前算是助推。取缔垃圾食品不算。”

助推理论在疫情期间并没有大放异彩。英国政府最初采用软性规劝，呼吁个人自觉防疫，比如打出“待在家里，拯救生命”的口号，而非实施封控等强硬措施，有人为此指责主张助推理论的行为科学家。在美国费城，政府推出奖金高达五万美元的彩票活动来提高疫苗接种率，但成效甚微。

2021年底，助推理论的拥趸终于听到了一些好消息。学者们首次尝试收集和评估该理论（它更正式的经济学名称是选择架构干预）的学术依据，结果令人鼓舞。日内瓦大学的心理学家分析了约200项助推研究，得出的结论是助推措施不仅总体上有效，而且作用相当明显。

行为学家使用名为“科恩d值”（Cohen's d）的指标来衡量作用大小。该值体现对照组和实验组之间平均结果的差异，得分为零意味着助推措施没起任何作用，超过0.8则被认为有非常大的作用。日内瓦大学的研究团队表

示，助推措施促进人们改变行为的科恩d值总体为0.43。这稳稳处于中等范围，足以引起大多数政策制定者的重视。

其他心理学家看到了这一结论，其中很多人不以为然。上个月，三个分别来自英国、匈牙利和美国的学术团体在《美国国家科学院院刊》（National Academy of Sciences）上发表了批评文章。之前瑞士研究团队的初步分析也发表于该刊。

批评者们有两个共通的观点。首先，那些学术试验采用的方法大不相同，所报告的作用大小也差异极大，合并在一起分析是没有意义的。笼统地说有“中等”作用是严重夸大了那些无效助推措施的作用，也低估了那些有效措施的好处。

其次，助推研究极易受发表偏差的影响，即学术期刊倾向发表那些报告最大作用的研究。批评者指出，在运用统计工具计入发表偏差的扭曲效应后，原来那些分析的平均作用暴跌，低至0.04，也就是说实际上毫无作用。

批评者之一的巴纳巴斯·萨兹（Barnabas Szasz）是布达佩斯大学的心理学家，他表示，这并不意味着所有的助推措施都是无效的。有个著名的例子表明，在小便池中配上苍蝇、高尔夫果岭旗等图像可以提高男性小便瞄准便池的几率，降低清洁成本。但在这样一个包含各种试验的混杂的元分析中，那些确实有明显作用的助推试验实际上被大量无用措施淹没。萨兹说，这样的元分析应该按类型把助推措施细分为不同组别。只有这样，决策者才能更好地衡量不同助推策略的作用，从最佳策略吸取经验。

“我们认同批评者提出的大多数观点。”乌尔夫·哈内尔（Ulf Hahnel）说，他是2021年开展最初的元分析的日内瓦大学研究团队的成员。他又表示，他们的研究无意把助推措施描绘成灵丹妙药，而且文章中也提醒了可能存在异质性和发表偏差的影响。

批评者说，这场争论突显出心理学家和其他社会科学家需要更努力地消除发表偏差。目前有一项倡议是让研究人员在项目开始前预先登记，而期刊

应同意无论结果如何都会发表研究报告。听取这建议的不多。是不是也该助推一下？ ■



The Economist Film

Interest rates and central banks - Part 1

When central banks raise interest rates, the impact is felt far and wide. So why do central banks do it?



经济学人视频

利率与央行（上）

央行提高利率的经济影响深远，它们为何这么做？



Oh, snap

The online-ad industry is being shaken up

A years-long bonanza is giving way to more uncertain times

FOR DIGITAL-AD sellers, 2021 was always going to be a hard act to follow. As work, play and shopping shifted online during the covid-19 pandemic, internet advertising boomed. In America spending rose by 38%, to \$211bn, compared with average annual growth of 21% in the preceding five years, according to eMarketer, a research firm. Smaller social-media firms such as Pinterest and Snap at times hit triple-digit year-on-year quarterly revenue growth. Even giants such as Alphabet (Google's parent company) and Meta (Facebook's and Instagram's), which receive a third and a fifth of the world's digital-ad dollars, respectively, clocked rates of 50%.

The contrast with 2022 is stark. On July 21st Snap reported that its sales grew by 13%, year on year, in the second quarter, its most anaemic ever. In a letter to investors, the firm confessed that so far this quarter revenue was "approximately flat". The market was spooked, and the company's share price fell by almost 40%. The next day Twitter, which also depends on advertising, reported that its revenue had fallen slightly in the three months to June, compared with last year.

That triggered concern about the health of online advertising, dragging down the share prices of the industry's titans. On July 26th Alphabet duly disclosed Snap-like quarterly sales growth of 13%, down from 62% in the same period last year. That was less terrible than expected (its market value rose by 8% on the news) but still pretty bad (it remains a bit below what it had been before the Snap bombshell). A day later Meta said that its revenue declined for the first time, by 1% year on year.

Upstart challengers like Snap are the most exposed. When marketing

budgets get trimmed, advertisers tend to stick to what they know, says Mark Shmulik of Bernstein, a broker. And they know Google search much better than they do Snap's experiments with augmented reality. The big firms also boast larger and more diverse sets of customers; Meta serves 10m advertisers globally, compared with Snap's estimated 1m or less. That insulates them somewhat from softening demand.

Somewhat, but not fully. Last year's covid-boosted baseline is not the only thing weighing on the digital-ad market. Ad-sellers are feeling the delayed effect of Apple's change last year to the privacy settings on iPhones, which stops advertisers from tracking people's behaviour on its devices, and thus from measuring the effectiveness of digital ads. Snap cited the Apple policy as a reason for recent weak results. Meta estimates that the change will shave \$10bn, or 8%, from its revenue this year.

Both Alphabet and Meta are also facing fiercer competition. TikTok, a Chinese-owned short-video platform beloved of Western teenagers, is taking eyeballs from American social media, and ad revenue with them. Perhaps more concerning, previously ad-incurious tech titans are also getting in on the action. In the past couple of years Amazon has built the world's fourth-biggest online-ad business. Apple has a small but growing ad operation. And Microsoft has just been named as Netflix's partner in the video-streaming giant's new ad-supported offering.

Another reason for the big ad-sellers' slowdown is similarly structural. For years they shrugged off blips in the broader economy, as many customers came to see online ads as a virtual shopfront that needed to be maintained even in tough times—often at the expense of other ad spending. That has left ever fewer non-digital ad dollars available to be diverted online. In a pinch, advertisers may now therefore need to take an axe to their digital billboards.

The pain isn't felt equally. Google, whose search ads rely less on the sort of tracking Apple has curbed, may have benefited from Meta's misery, helping offset some of the slowdown. On July 27th Spotify bucked the trend among challenger platforms, reporting unexpectedly healthy ad revenues from its music-streaming service, which helped buoy its share price by 12%. Even so, the business cycle may be catching up with big tech. ■



啊，糟了

网络广告业地动山摇

多年的滚滚财运到头，更不确定的年代来临

对于数字广告销售商来说，2021年的盛景将难以重现。疫情期间，工作、娱乐和购物都转移到线上，网络广告如火如荼。根据研究公司eMarketer的数据，美国数字广告的支出增长了38%，达到2110亿美元，而在此之前的五年里的平均年增长率为21%。Pinterest和Snap等规模较小的社交媒体公司在某些季度里收入同比增长甚至达到三位数。就连分别拿走了全球数字广告收入三分之一和五分之一的巨头Alphabet（谷歌的母公司）和Meta（Facebook和Instagram的母公司）增速也达到50%。

这与2022年形成了鲜明对比。7月21日，Snap报告称公司第二季度销售额同比增长13%，是有史以来最疲软的。公司在致投资者的一封信中承认，当前季度到目前为止营收与去年同期“大致持平”。市场惊恐不已，Snap的股价大跌近40%。第二天，同样依赖广告业务的推特称，与去年同期相比，其收入在截至6月的三个月里略有下降。

这引发了人们对在线广告业务状况的担忧，拉低了行业巨头们的股价。7月26日，Alphabet如期公布了季度业绩，显示广告营收增长了13%，与Snap接近，但去年同期为62%。这没有预想的那么糟糕（消息传出后，其市值上涨了8%），但仍然相当差劲（市值目前仍略低于它在Snap扔出重磅炸弹前的水平）。一天之后，Meta表示其收入首次下滑，同比下降1%。

Snap等新晋挑战者受到的冲击最大。券商盛博的马克·舒姆里克（Mark Shmulik）认为，营销预算被削减时，广告主往往会继续选择他们熟知的平台。而他们对谷歌搜索的了解要远多于Snap的增强现实探索。大公司也拥有更庞大、更多样化的客户群；Meta为全球1000万广告主服务，而Snap的广告客户估计只有100万或更少。这在一定程度上让巨头们免受需求疲软的影响。

但并不是完全没有影响。去年的基准线因疫情而拉高并不是令数字广告市场承压的唯一因素。去年苹果更改了iPhone上的隐私设置，广告客户无法再追踪用户在其设备上的行为，也就无法再衡量数字广告的有效性，现在广告销售商感受到了这项举措的延迟效应。Snap将苹果的这一政策列为近期业绩疲弱的原因之一。Meta估计这一变化会让它今年的收入减少8%，即100亿美元。

Alphabet和Meta也都面临着更加激烈的竞争。受西方青少年喜爱的中国短视频平台TikTok正从美国社交媒体那里夺取受众，也一并分走了广告收入。更令人担忧的也许是那些以前没把广告业务放在心上的科技巨头也参与了进来。过去几年里，亚马逊的网络广告业务达到全球第四大。苹果的广告业务规模虽小，但在不断增长。此外，微软刚刚被选定为奈飞的合作伙伴，参与这家视频流媒体巨头新推出的由广告支持的服务。

大型广告销售商增长放缓的另一个原因也是结构性的。多年来，他们对整体经济的波动不以为然，因为许多客户往往将网络广告视为即使在困难时期也需要维持的虚拟店面——通常以牺牲其他广告支出为代价。这已经让能够被转移到线上的非数字广告预算越来越少。到了万不得已之时，广告主现在可能要砍掉他们的数字广告。

各家的痛苦并不相通。谷歌的搜索广告较少依赖已被苹果限制的追踪，因而可能从Meta的不幸中受益，抵消一部分减速。7月27日，Spotify在挑战者中逆势而上，意外地报告了它在音乐流媒体服务上不俗的广告收入，助推其股价上涨了12%。即便如此，商业周期可能还是快追上科技巨头了。





The Economist Film

Interest rates and central banks - Part 2

It may be a blunt instrument, but raising interest rates is still central banks' main tool for taming inflation.



经济学人视频

利率与央行（下）

加息可能是一件不那么好用的工具，但它仍然是央行驯服通胀的主要工具。



Technology and terminology

In “The Metaverse”, Matthew Ball explains where the idea came from

And where it might be going

The Metaverse. By Matthew Ball. Liveright; 352 pages; \$30. W.W. Norton; £22

DO YOU REMEMBER the information superhighway? In the early 1990s pundits predicted that high-speed data networks would soon connect millions of people, letting them exchange information and linking them to “movies and television shows, shopping services, electronic mail and huge collections of data”, as the New York Times put it. Yet today millions use Netflix and Amazon, Gmail and Wikipedia, and no one talks of “cruising the information superhighway”—or ever did. The vision was prescient, but the jargon died.

Something similar may now be happening with the term “metaverse”. It is also the subject of feverish speculation—this time about the possibilities of 3D virtual worlds, and a sense that video-game technology and online communication are converging in interesting ways. But its definition is elusive, and none of the multitudes who congregate in virtual worlds today, such as players of the game “Fortnite”, actually use the word.

It broke into public consciousness in October 2021, when Facebook renamed itself Meta, signalling its ambitions in this new arena. People who had not previously heard the word “metaverse” assumed it was a new Facebook product. But the term has been used in tech circles for years, and other companies, including Microsoft and Roblox, had in fact already staked their own claims to be metaverse merchants.

Metaverse is a relatively new name for an old idea, explains Matthew Ball, a technology analyst (and occasional contributor to The Economist), in his

survey of the topic. The word was coined in 1992 by Neal Stephenson in his novel “Snow Crash”. Mr Ball traces the concept of a parallel, synthetic reality back to “Pygmalion’s Spectacles”, a short story of 1935 by Stanley Weinbaum, and later tales by Ray Bradbury, Philip K. Dick, Isaac Asimov and William Gibson. Strikingly, all their synthetic worlds are dystopias—a detail modern tech bosses have failed to notice, or chosen to ignore.

Mr Ball’s summary of the history of virtual worlds, in both fiction and computer science, provides helpful context. But his book’s most valuable contribution may prove to be his definition of the metaverse: an interoperable network of 3D virtual worlds that can be accessed simultaneously by millions of users, who can exert property rights over virtual items.

This definition is interesting as much for what it leaves out as for what it includes. It is not simply a rebranding of virtual reality: headsets are optional, and today virtual worlds are mostly accessed using flat screens. Nor are blockchains or non-fungible tokens mentioned, though Mr Ball concedes they may have a role. He insists that, just as there is only one internet, made up of many different networks and services that have more value for being connected, there should be only one metaverse, made up of many virtual worlds.

Given that virtual worlds already exist, the next steps will include scaling them up to support more users (online games carefully limit their numbers), making them more realistic and accessible, and devising new hardware to allow greater immersion. Progress is being made on all those fronts. But by far the biggest challenge will be to make connections between what are currently separate worlds. For example, it is not yet possible to take an item of virtual clothing from “Fortnite” into “Minecraft”.

Mr Ball is optimistic that “economic gravity” will drive companies to co-

operate in devising and adopting open standards, because the market that this will unlock will be much bigger than any of them could create alone. He adduces the so-called protocol wars of the 1970s-90s, when rival computer-networking standards vied for supremacy. Ultimately an open standard prevailed, the Internet Protocol, because a common format created a bigger market.

Similarly it makes economic sense, Mr Ball argues, for virtual worlds to share data and interoperate. Today people buy fewer objects inside games and other virtual worlds than they might if ownership rights were firmer and items more portable. Tackle those problems, and more people might be willing to fork out. Economics, Mr Ball says, “will drive standardisation and interoperation over time”.

He draws an illuminating analogy with the history of smartphones. Another way to think of the metaverse, he points out, is as the successor to the rise of the mobile internet. Mobile devices extended, but also changed, the way people experience the internet, with the advent of things like navigation apps and ride-hailing. The metaverse could represent a comparable kind of shift, transforming what the internet can do and how it is used.

But isn't the smartphone industry dominated by the duopoly of Apple and Google? This is one case where “economic gravity” has not led to interoperability. Mr Ball thinks regulatory action is needed to loosen the duo's grips on payment systems and app stores, which “limit the growth potential not only of virtual-world platforms, but also the internet at large”.

The author wisely avoids spending too much time trying to imagine all the future uses of the metaverse, or analysing which of today's tech giants are best-placed to exploit it. Nor does he dig very deeply into the inevitable regulatory and governance challenges. It is far too early in the game. Think

of those predictions from 1993: they were broadly correct, but Netflix, Amazon, Gmail and Wikipedia did not exist. The rise of smartphones, too, toppled previous industry leaders. The metaverse could cause a similar changing of the guard.

Even the word metaverse may not stick, Mr Ball admits. Something like it will have arrived by the end of the decade, but “we may ultimately use a different term for this future”. Like the information superhighway, this latest buzzword seems to point in the right direction, but may get lost along the way. For anyone who wants to understand the process and what is at stake, Mr Ball’s lucid and timely book offers a portal into a new realm. ■



科技与术语

在《元宇宙改变一切》中，马修·鲍尔解释了“元宇宙”概念的起源及其未来可能的走向【《元宇宙改变一切》书评】

《元宇宙改变一切》，马修·鲍尔著。Liveright出版社，352页，30美元；诺顿出版社，22英镑。

你还记得“信息高速公路”这个词吗？上世纪90年代初，《纽约时报》就曾报道，专家们预测高速数据网络将很快把数以百万计的人连接起来，让他们能够交换信息，并连上“电影和电视节目、购物服务、电子邮件和海量数据”。然而现如今，尽管无数人在使用奈飞、亚马逊、谷歌邮箱和维基百科，却没有人说“在信息高速公路上漫游”，而且也没有人这么说过。虽然“信息高速公路”的构想很有先见之明，但这个术语却消亡了。

现在，类似的情况可能正发生在“元宇宙”上。它也是人们热炒的话题——这次是关于3D虚拟世界的各种可能性，以及视频游戏技术和在线交流以有趣的方式汇聚融合。但它的定义含混不清。事实上，如今那些聚集在虚拟世界中的网民——比如《堡垒之夜》（Fortnite）的玩家——没有谁真的使用这个词。

去年10月，Facebook更名为Meta，彰显它在“元宇宙”这个新赛道上的雄心壮志，这个词也由此闯入了公众的头脑。以前没有听说过“元宇宙”的人还以为它是Facebook的新产品。但这个词已经在科技圈使用多年，而且包括微软和Roblox的其他公司其实早就公开宣称自己已入驻元宇宙。

偶尔也为本刊撰稿的科技分析师马修·鲍尔（Matthew Ball）在对这一话题的探讨中指出，元宇宙这个名称相对较新，但背后的概念并不新奇。这个词是1992年尼尔·斯蒂芬森（Neal Stephenson）在其小说《雪崩》（Snow Crash）里创造的。鲍尔将与真实世界平行的合成现实这一概念追溯至1935年斯坦利·温鲍姆（Stanley Weinbaum）的短篇小说《皮格马利翁的眼镜》（Pygmalion's Spectacles），以及后来的雷·布莱伯利

（Ray Bradbury）、菲利普·迪克（Philip K. Dick）、艾萨克·阿西莫夫（Isaac Asimov）和威廉·吉布森（William Gibson）等人书写的故事。引人注目的是，这些作者笔下的合成世界都是反乌托邦的——这一点是当今科技公司的老板们没有注意到的，也可能是故意视而不见。

无论是小说里的还是计算机科学中的虚拟世界，鲍尔对其历史所做的总结都有助于我们了解它们的来龙去脉。但他这本书最重要的贡献可能是他对元宇宙的定义：一个可让数以百万计用户同时访问且可互操作的3D虚拟世界网络，这些用户可行使对虚拟物品的财产权。

这个定义挺有意思——既在于它提到的，也在于它没有提到的。它不只是重新定义了虚拟现实：头显不是必备品，如今的虚拟世界大多是使用平板显示器访问的。它也没有提到区块链或非同质化代币，尽管鲍尔承认它们可能也有一席之地。他坚持认为应该只有一个由许多虚拟世界组成的元宇宙，就像只有一个由许多不同网络和服务组成的互联网一样，这些网络和服务连接在一起时更有价值。

鉴于各种虚拟世界已经存在，接下来要做的事将包括扩大其规模以容纳更多用户（在线游戏则会小心翼翼地限制用户数）；让它们更逼真、更易于访问；设计新硬件，让用户的沉浸感更强。所有这些方面都在取得进展。但无疑最大的挑战将是把当前各个互不相干的虚拟世界连接起来。例如，目前还不能把《堡垒之夜》中的一件虚拟服装携带进《我的世界》（Minecraft）。

鲍尔乐观地认为，“经济引力”会推动各家公司合作设计和采用开放标准，因为这样做打开的市场会比其中任何一家公司单打独斗所开创的市场大得多。他以上世纪70至90年代的“网络协议争夺战”为例证，当时各种计算机网络标准都在争夺主导权。最终一种开放的标准——互联网协议（Internet Protocol）胜出，因为通用格式开创了更大的市场。

同样，鲍尔认为，虚拟世界要实现数据共享和互操作才有经济效益。如今人们在游戏和其他虚拟世界里购物还不是那么多，因为物品的所有权还不

够牢靠也不容易转移。解决了这些问题后，或许会有更多人愿意掏腰包。鲍尔表示，经济效益“会逐渐推动标准化和互操作性”。

他用智能手机的历史做了一个易于理解的类比。他指出，从另一个角度来看，元宇宙就好比移动互联网兴起的后继者。随着导航应用和叫车服务等事物的出现，移动设备扩展了人们的互联网体验，但同时也改变了这种体验。元宇宙可以是一种类似的转变，给互联网的作用和使用方式带来变革。

但智能手机行业不是被苹果和谷歌双头垄断了吗？这是“经济引力”没有导致互操作性的一个例子。鲍尔认为，需要采取监管措施，减弱这两家公司对支付系统和应用商店的主宰，因为它“限制了虚拟世界平台乃至整个互联网的增长潜力”。

作者很明智，没有花太多笔墨去想象元宇宙未来的所有用途，也没有分析今天哪些科技巨头在开发元宇宙方面处于最有利的地位。他也没有深入探讨不可避免的监管和治理难题。现在说这些还为时过早。想想1993年的那些预测：它们大体上是正确的，但那时候奈飞、亚马逊、Gmail和维基百科都还不存在。智能手机的兴起也把之前的行业领袖撵下了台。元宇宙可能也会导致类似的改朝换代。

鲍尔承认，就连“元宇宙”这个词可能也不会一直流传下去。到本个十年末会有一个差不多的事物，但“我们最终可能会用一个不同的术语来指称这一未来”。就像信息高速公路一样，“元宇宙”这个最新的流行语看起来指向了正确的方向，但其本身有可能在中途消失。对于任何想要了解这一进程及其影响的人来说，鲍尔这本清晰易懂的书非常及时地提供了一个通向新天地的门户。■



Schumpeter

Meet Keyence, consultant to the world's factories

Unlocking the secrets of an unlikely profit machine

Keyence is not exactly a household name, even by the low-key standards of corporate Japan. Ask most people, including some professional market-watchers, and the odds are they will struggle to say much about it. Put the same question to the world's factory-owners, and they will recognise it instantly. Founded in 1974 by Takizaki Takemitsu, a young entrepreneur without a university degree, the company has for decades been helping manufacturers get the most out of their factories with sensors and robotics. Its clients include giants from just about every industry, from aerospace (Boeing) to semiconductors (Samsung and TSMC).

As automation takes hold of industrial bosses' imagination, they are willing to pay handsomely for Keyence's services, which include designing clever kit and helping clients integrate it into their operations. Its revenues have nearly trebled since the early 2010s, to \$6.7bn. Profits have grown faster still: the firm's operating margin now exceeds 50%; net margin has averaged 36% over the past decade, 13 percentage points higher than that of famously profitable Apple. Today it is Japan's fourth-most-valuable company, worth more than \$90bn. Even after the recent stockmarket slump its share price is nearly ten times higher than a decade ago. Last year Mr Takizaki briefly became the richest person in Japan.

This rip-roaring success is something of a riddle. Few companies of any size enjoy that sort of profitability. Especially among big firms like Keyence, those that do tend to belong to one of three groups: regulated champions (think Saudi National Bank), dominant firms in industries with large barriers to entry (such as TSMC, whose chip factories cost \$20bn a pop, or its Dutch supplier of chipmaking gear, ASML), or unregulated de facto

monopolies in technology markets (Alphabet in online search, for example).

Keyence is none of these. Regulators mostly ignore its market. It is “fables”, dreaming up its gizmos but outsourcing their production to contract manufacturers; its capital spending is negligible and it devotes barely 2-3% of revenue to research and development, compared with around 9% for TSMC. And its designs are bespoke, and as such would seem to benefit less from economies of scale. You can think of it as the management consultant to the world’s factories. Like McKinseyites, its engineers act as its only sales reps, tasked with bringing in business to the firm; the company employs no specialised sales team and its offerings cannot be bought from anyone else. These sales engineers, if you will, are also akin to consultants by being embedded within a client firm for a time to see how it ticks—and how it might tick better.

McKinsey, though, must fight for clients with rivals such as Bain or BCG; Accenture, a rare listed consultancy among what are mostly opaque private partnerships, reports net profits equal to roughly 10% of sales. Keyence, by contrast, faces no real competition. Firms that have tried to enter its market, such as Basler of Germany and Omron, a fellow Japanese company, are about a quarter as lucrative and have not competed away its margins. If anything, Keyence’s have been edging up in recent years. So how does a company that does not make anything and invests next to nothing pull this off? And can it keep doing so?

Explanations of Keyence’s remarkable run usually start with its focus on its clients. People who have witnessed up close the relationship between the company’s engineers and those who employ their services describe a painstaking process of optimisation. Without Keyence’s engineers to ensure that all possible efficiencies are eked out, factories risk a bit more downtime and a bit less productivity, which can prove crippling in markets

more competitive than the Japanese firm's, which is to say most of them. Engaging with analysts, investors and the odd journalist is an afterthought: a distraction that is best kept to a minimum.

Keyence's second trump card is its approach to personnel. Even by Japanese standards, working for the company is regarded as a relentless slog. But the sales engineers are compensated handsomely for their dual roles. The average salary it paid in the last financial year was ¥22m (\$196,000). It regularly ranks as the country's highest-paying large company, above banks and other financial firms. This draws in ambitious youngsters who, also like many management consultants, put in a few years of hard graft before moving on. The average age of its employees is 36, far below the Japanese median age of 49.

The third factor behind the company's success is the breadth of its order book. It works for almost every large global manufacturer of note, ranging from aliments to aeroplanes. When a client brings in Keyence consultants, it is benefiting from their accumulated knowledge of best practice across most manufacturing subsectors. That may include insights from the client's direct rivals, which are also likely to rely on Keyence's services.

| *McKeyence & Company*

This is yet another similarity to management consultancies, which likewise enjoy access to the inner workings of their clients' rivals. Where Keyence has an edge over the McKinseys and Bains is in its more specialised offerings. That makes the self-reinforcing stockpile of institutional knowledge harder for rivals to replicate. This phenomenon of scale begetting more scale is reminiscent of big tech's vaunted network-effect "flywheels".

Keyence is not without challenges. This year's global tech crunch has shaved around \$60bn from its market capitalisation. As once-placid

investors in Japan become more assertive they may press the company to do something with its large cash holdings of around \$8bn. And even tech flywheels with seemingly unstoppable inertia can be disrupted—just ask Meta, whose social-media dominance is under threat from TikTok, a Chinese upstart. Until that happens, though, manufacturing bosses around the world will happily keep enlisting platoons of Keyence sales engineers with a tacit understanding of what their competitors are up to. ■



熊彼特

认识下基恩士，全球工厂的咨询师

解密一台不可思议的盈利机器

即使以日本公司向来低调的做派衡量，基恩士（Keyence）也算不上是家喻户晓的名字。大多数人——甚至包括一些专业的市场观察家——恐怕都对这家公司说不出个所以然。但如果你去问问世界各地的工厂主，他们对它可是耳熟能详。没上过大学的年轻企业家滝崎武光在1974年创办了这家公司，几十年来一直在用传感器和机器人技术帮助制造商在自己的工厂中取得最大效益。从航空航天领域的波音，到半导体行业的三星和台积电，几乎各行各业的巨头都是它的客户。

自动化占据了工业企业老板们的想象，他们愿意为基恩士的服务支付不菲的费用，包括设计智能装置并将之整合到运营当中。自2010年代初以来，该公司的收入增长近两倍，达到67亿美元。利润增长更快：公司的营业利润率现已超过50%；过去10年的平均净利润率为36%，比以盈利著称的苹果还要高13个百分点。如今，它是日本市值第四高的公司，价值超过900亿美元。即使近期股市暴跌之后，其股价仍比十年前高近十倍。滝崎去年一度成为日本首富。

这种巨大的成功像是一个谜。无论公司规模大小，能有如此盈利水平的少之又少。尤其是基恩士这样的大公司，能够实现高额利润的往往属于以下三种类型之一：受监管的龙头企业，例如沙特国家银行；在高门槛行业中占据主导地位的企业，例如台积电（它的单家芯片工厂造价高达200亿美元），以及它的荷兰芯片设备供应商阿斯麦（ASML）；或者在科技市场中不受监管的事实垄断者，例如在线搜索领域的Alphabet。

基恩士不属于以上任何一类。监管机构对它的市场基本不闻不问。它“无厂”，只构思设计，把生产外包给代工厂；它的资本支出微不足道，研发支出仅占营收的2%到3%，相比之下，台积电的这一比例约为9%。而且它的设计是定制化的，也就难以从规模经济中获得多少好处。你可以把它看

成世界上各个工厂的管理顾问。和麦肯锡的咨询师一样，它的工程师充当唯一的销售代表，负责为公司带来业务；公司没有专门的销售团队，其产品和服务无法从任何其他渠道购买。你愿意的话，也可以把他们看作销售工程师，和咨询师一样，他们也会深入客户公司一段时间以了解其运作——然后研究如何让它运作得更好。

不过，麦肯锡必须与贝恩或波士顿咨询等竞争对手争夺客户；多数咨询公司是不透明的私人合伙企业，埃森哲（Accenture）是其中少有的上市公司，其净利润约为营业额的10%。相比之下，基恩士没有什么真正的竞争对手。试图进入其市场的公司，如德国的Basler和另一家日本公司欧姆龙（Omron），利润率只有它的四分之一左右，而且也并没有影响到它的盈利。要说有什么变化，它的利润近年来还一直在稳步上升。那么，一家不生产任何产品、几乎不做投资的公司是怎么做到这一点的？未来还能继续保持吗？

对基恩士非凡业绩的解读通常都从它对客户的关注开始。那些曾近距离目睹该公司的工程师与其客户互动的人表示这是一个呕心沥血的优化过程。如果没有基恩士的工程师来挖掘出一切可能的效率提升，工厂可能就有停工时间多一点、生产效率低一点的风险，而这在大多数市场里都可能是致命的（毕竟大多数市场都比这家日本公司自己所在的市场竞争更激烈）。与分析师、投资者和偶尔的记者打交道都还是后头的事情：这类干扰越少越好。

基恩士的第二张王牌是它的用人之道。即使按照日本的标准，这家公司的工作强度也被认为是无情的苦役。但是，销售工程师的双重角色给员工带来了丰厚的报酬。上个财政年度，该公司支付的平均工资为2200万日元（19.6万美元）。它经常跻身全日本薪酬最高的大公司之列，超过银行和其他金融企业。这吸引了雄心勃勃的年轻人，他们和许多管理顾问一样，会拼命工作几年后再转行。其员工的平均年龄为36岁，远低于日本49岁的中位数年龄。

该公司成功背后的第三个因素是它的订单来源广泛。它几乎服务全球所有

的大型知名制造商，从食品到飞机均有涉猎。当客户聘请基恩士的顾问时，会受益于他们积累的关于大多数制造业子行业最佳实践的知识。其中可能包括来自该客户的直接竞争对手的见解，这些对手很可能同样依赖基恩士的服务。

| 基恩士咨询

这是它与管理咨询公司的又一个相似之处，后者同样可以接触到客户的竞争对手的内部运作。基恩士相对于麦肯锡和贝恩的优势是它的服务更专门化。这形成了自我强化的系统性知识储备，更难被竞争对手复制。这种以规模催生更大规模的现象让人联想到大型科技公司吹嘘的“飞轮”网络效应。

基恩士并非没有挑战。今年的全球科技股崩盘让它的市值缩水了约600亿美元。随着曾经沉稳平和的日本投资者变得更加强势果断，他们可能会敦促这家公司用持有的约80亿美元巨额现金做点什么。而即使看似有着无休止的惯性，科技飞轮也可能被中断——Meta就是一个例子，它在社交媒体中的主导地位正受到来自中国的新贵TikTok的威胁。不过，在那之前，世界各地的制造业老板会乐此不疲地请来一批又一批基恩士销售工程师——这些人对他们的竞争对手的动向可是心知肚明的。■



Having its moment

Can Watershed corner the market for carbon accounting?

The climate-software startup is all the rage in Silicon Valley

The hottest thing in business depends on where you are. Bars in San Francisco tend to be abuzz with talk of enterprise software. Regulars at City of London pubs may discuss sustainable investing, and in particular concern for environmental, social and governance (ESG) factors. Combine the two subjects and you have a winner—both as a topic of conversation and, hopes Watershed, a fast-growing climate-software startup, as a business proposition.

Watershed seems an unlikely subject of animated discussion. It helps companies measure and report their carbon emissions. It is, in other words, a firm of carbon accountants—not usually a profession to set pulses racing. What makes it titillating is its potentially vast market. Over a third of the world’s investable assets, or some \$35trn-worth, falls under the ESG umbrella, and a large chunk of that is chiefly about the E. Someone has to count the emissions from all those assets. And Watershed could be that someone, reckons a clutch of worthies from Silicon Valley (John Doerr of Kleiner Perkins and Michael Moritz of Sequoia Capital, veteran venture capitalists, co-led its last funding round) and beyond (Mark Carney, former governor of the Bank of England turned climate warrior, is an adviser). In January the firm raised \$70m at a valuation of \$1bn.

Businesses spew some carbon directly (by operating a vehicle fleet, say). Most also buy some electricity from the grid, which may be fossil-fuelled. And they are at least in part responsible for the emissions produced up and down their value chain. This particular indirect kind, known as “scope three”, makes up the bulk of most firms’ carbon impact. It is also devilishly hard to measure, especially across a complex web of suppliers and

customers. Watershed's algorithms ingest information about line items in its clients' books and match them with data on the carbon cost of those activities. The result is a granular picture of a firm's carbon footprint, says Taylor Francis, the firm's co-founder.

The market for carbon-accounting technology could get a regulatory boost. In America the Securities and Exchange Commission has proposed a rule that would require some firms to report their scope-three emissions. The European Union has issued broader rules that, when implemented, could make nearly 50,000 firms subject to reporting requirements. Some firms will try to do this on their own. Many will enlist specialists like Watershed.

The company is already facing competition. Persefoni ai, a startup in Arizona, is popular with finance firms. Business-software giants like Salesforce and IBM may get in on the action. As for demand, regulators could get cold feet or, in America, be forced to relax disclosure rules by the Supreme Court, whose conservative majority spies executive-branch overreach in climatic matters. For now, though, Europe is moving full-steam ahead and American investors are demanding more details on firms' carbon footprints, whatever the justices think. Mr Francis says that Watershed's client list includes big names in tech (for example, Stripe and Spotify) and, more recently, in retail (Walmart). How's that for a conversation starter? ■



高光时刻

Watershed会统领碳会计市场吗？

这家气候软件创业公司在硅谷风头正劲

商业圈子里什么东西最热门取决于你身处何地。旧金山的酒吧里往往有很多人大谈企业软件。伦敦金融城酒馆里的常客也许会讨论可持续投资，尤其关注环境、社会和治理（ESG）因素。把这两个主题结合起来，你就赢了——既有了一流谈资，也可能像迅速扩张中的气候软件创业公司 Watershed 希望的那样，有了一个成功的商业计划。

Watershed 似乎不太可能成为人们热议的话题。它帮企业测算和报告碳排放。换句话说，它是一家碳会计事务所——这一行一般不会让人心跳加速。真正让人兴奋的是它庞大的潜在市场。全球超过三分之一的可投资资产（价值约35万亿美元）属于ESG的范畴，其中很大一部分主要和“E”即环境相关。必须得有人来统计所有这些资产的排放量。而在一些大人物看来，Watershed 就可能成为这个统计者。这些人有的来自硅谷，比如凯鹏华盈（Kleiner Perkins）的约翰·杜尔（John Doerr）和红杉资本（Sequoia Capital）的迈克尔·莫里茨（Michael Moritz），这两位资深风险投资家共同领投了 Watershed 上一轮融资；此外还有从英国央行行长变身气候斗士、出任 Watershed 顾问的马克·卡尼（Mark Carney）等人。今年1月，Watershed 融资7000万美元，估值达10亿美元。

企业会直接排放一部分碳（如公司用车）。它们大多数还会从电网购买一些电力——可能是化石燃料发电。而它们至少还要对其价值链上下游产生的部分排放负责。这个间接排放类别，也就是大家所说的“范围3”，构成了大部分公司碳影响的大头。这部分排放也极难测算，尤其是牵涉到供应商和客户的复杂网络。Watershed 的算法从客户账目中提取各项明细，并与这些活动的碳成本数据相匹配。这样就能给出一家公司碳足迹的细分图，该公司的联合创始人泰勒·弗朗西斯（Taylor Francis）说。

碳会计技术的市场可能会受到监管的推动。在美国，证券交易委员会

(SEC) 公布了一份规则提案，要求一些公司报告它们的范围3排放。欧盟已经发布了范围更广的规则，一旦实施，将有近5万家公司需要满足上报要求。有些公司会试着自己完成。许多公司则会雇用Watershed这样的专家。

这家公司已经有了竞争对手。亚利桑那州的创业公司Persefoni AI颇受金融公司的欢迎。像Salesforce和IBM这样的商业软件巨头可能也会参与进来。至于需求，监管机构可能临阵退缩，而美国的监管部门可能会被最高法院强制要求放松披露规则——该院占多数席位的保守派盯牢行政部门是否在气候问题上越权。不过，就目前而言，欧洲正全速推进，且不管大法官们怎么想，美国的投资者也在要求获得更多关于企业碳足迹的详情。弗朗西斯表示，Watershed的客户名单包括科技界响当当的名字（如Stripe和Spotify），最近零售大咖（沃尔玛）也加入了进来。拿这个做聊天的开场白怎么样？ ■



Free exchange

How high property prices can damage the economy

A fresh strand of research studies the consequences, both in China and the rich world

ECONOMISTS' INTEREST in land has waxed and waned over time. For the political economists of the 18th and 19th centuries, it was central to understanding the world. They believed that the distribution of rents from land ownership could explain the yawning gaps between the rich and poor, and all sorts of other economic ills. Economists cared less about land in the 20th century. Since the turn of the millennium, however, they have increasingly debated the impact that restrictive zoning laws have on the economic output of cities. The global financial crisis sparked an increase in research on the consequences of property slumps. Banks' balance-sheets tend to weaken, and worried homeowners spend less, potentially triggering a recession. America's housing crash during 2007-09 in particular was much studied.

In recent years another strand of research has emerged, which, rather like the political economists of yore, attributes many long-standing economic ills to land. It explores how high and rising land prices affect lending, investment and ultimately productivity, and much of it looks closely at China's long property boom. The worrying conclusion is that high and rising property prices can also have damaging economic effects, by crowding out productive investment and leading to a misallocation of capital. In the most extreme cases, inflated land prices may already be the cause of a protracted slowdown in productivity growth.

Real estate is the largest asset class in the world. In 2020 it made up around 68% of the world's non-financial assets (which includes plant and machinery as well as intangibles, such as intellectual property). Land, rather than the structures built on top of it, accounts for slightly over half

of that 68%. As values have ballooned, the share of land in non-financial assets has increased sharply in some countries (though few report the data). In Britain, for instance, it went from 39% in 1995 to 56% in 2020.

Because land can easily be valued and cannot be hidden or broken, it is good collateral to borrow against. So when prices are rising, as they have in most places for much of the past few decades, the initial effect is to boost lending and economic activity. Households can use their increasingly valuable property to borrow at lower interest rates than they otherwise would. Land-owning firms, too, can access finance more easily. Fatter asset holdings also make people feel more comfortable spending money.

But the use of land as collateral has harmful effects, too, especially in places where banks play a big role in financing companies. Firms' ability to borrow tends to be determined by their existing assets, rather than their productive potential. And those that own land find it much easier to borrow from banks than those, say, with lots of intangible assets. A paper published in 2018 by Sebastian Doerr of the Bank for International Settlements found that listed American firms with more property collateral were able to borrow and invest more than their competitors, even though they were less productive. These effects were also evident in Spain just before the global financial crisis. In research published last year, Sergi Basco of Universitat Barcelona and David Lopez-Rodriguez and Enrique Moral-Benito of the Bank of Spain noted that property-owning manufacturers in the country tended to receive more bank credit than other firms.

Rising property prices can also discourage productive lending, and lead to capital being misallocated. When housing markets boom, banks tend to engage in more mortgage lending. But because lenders face capital constraints, this is often accompanied by reduced lending to businesses. One paper, published in 2018 and looking at data from America between

1988 and 2006, found that a one-standard-deviation increase in house prices in areas where a bank has branches reduced lending growth to firms that borrow from the same bank by 42%. The total investment undertaken by the affected firms fell by 21%. Such crowding-out effects may have been sizeable in other places too, considering that banks around the rich world have sharply increased their mortgage lending. Across 17 advanced economies, mortgages' share of total bank loans climbed from 32% in 1952 to 58% in 2016 (the latest year for which data are available).

Whatever the effects of high land prices in the West, the scale of the problem in China appears even bigger, given that the country's investors have a huge appetite for real estate. A range of recent research suggests that China's high land prices shift bank lending away from land-light manufacturers and reduce spending on research and development by listed firms; they also appear to lead to a reallocation of managerial talent towards the property sector. One especially striking result comes from a paper published in 2019 by Harald Hau of the University of Geneva and Difei Ouyang of the University of International Business and Economics in Beijing, based on data from manufacturers in 172 Chinese cities. It concludes that a 50% increase in property prices would raise borrowing costs, reduce investment and productivity, and result in a 35.5% decline in the firms' value-added output.

| *Hitting home*

The conclusion that high and rising property prices can throttle economic activity carries important implications for how policymakers should treat investment in land and housing. Encouraging much more housebuilding, for instance, would help deflate collateral values. Restricting the ownership of multiple properties would alter the distribution of that collateral. And limiting the amount of mortgage lending banks can do might lead more credit to flow to productive purposes.

A more ambitious idea would be to tax land values, which, by lowering the market value of land, might reduce its attractiveness as collateral. Such a tax was, funnily enough, the goal of many 18th- and 19th-century reformers as they sought a more equal society. A new obsession with land could well revive an old idea. ■



自由交流

高房价何以可能破坏经济

一个新的研究方向探讨其后果——在中国以及发达国家

在不同时期，经济学家对土地的兴趣高低起伏。对于18和19世纪的政治经济学家来说，土地是理解世界的核心。他们认为土地所有权带来的租金分配可以解释巨大的贫富差距，以及其他各种经济弊病。到20世纪，经济学家对土地的关注度有所降低。然而，进入新千年以来，他们日益热烈地讨论起限制性区划法对城市经济产出的影响。全球金融危机引发了对房地产滑坡的后果的更多研究。银行的资产负债表趋于弱化，忧心忡忡的房主减少消费，有可能引发经济衰退。美国2007到2009年的房地产崩盘尤其被大量研究。

近年来出现了另一个研究方向。与昔日的政治经济学家一样，它将许多长期存在的经济弊病归咎于土地。它探讨了土地价格高涨对信贷、投资以及最终对生产率的影响，其中有很大一部分聚焦于中国长期的房地产繁荣。令人担忧的结论是，高企且不断上涨的房价还可能对经济产生破坏性的影响，因为它挤占了生产性投资，导致资本错配。在最极端的情况下，土地价格膨胀可能已经造成生产率增速长期放缓。

房地产是世界上最大的资产类别。2020年，它占全球非金融资产（包括工厂、机器以及知识产权等无形资产）的68%左右。在这68%当中，土地（不包括其上的建筑）占了一半多一点。随着地价膨胀，土地在一些国家非金融资产中所占的份额急剧上升（尽管少有报告数据）。以英国为例，该比例从1995年的39%上升至2020年的56%。

因为土地易于估价，也无法隐藏或损毁，它成了良好的贷款抵押品。因此当土地价格上涨时——过去几十年里大多数地方都是如此，最初的效果是促进了信贷和经济活动。家庭可以利用自己日益增值的房产，以低于原本水平的利率借贷。拥有土地的公司也更容易获得融资。手里的资产增值也让人们更安心地花钱消费。

但是，用土地作抵押也有不利的一面，尤其是在公司融资严重依赖银行的地方。企业能借到多少钱往往取决于其现有资产，而不是其生产潜力。相对于那些拥有大量无形资产的企业，拥有土地的企业获得银行贷款要容易得多。国际清算银行的塞巴斯蒂安·多尔（Sebastian Doerr）在2018年发表的一篇论文发现，拥有更多房地产抵押品的美国上市公司能够比竞争对手更多地借贷和投资，哪怕它们的生产率更低。在全球金融危机爆发前夕的西班牙，这种效应也相当明显。在去年发表的研究中，巴塞罗那大学的塞尔希·巴斯科（Sergi Basco）和西班牙央行的大卫·洛佩斯-罗德里格斯（David Lopez-Rodriguez）和恩里克·莫拉-贝尼托（Enrique Moral-Benito）指出，在西班牙，拥有房产的制造商往往比其他公司拿到了更多银行贷款。

房地产价格上涨也会阻碍生产性贷款，导致资本配置不当。房地产市场繁荣时，银行更愿意发放更多房贷。但由于银行的资本是有限的，这往往导致对企业贷款随之减少。2018年发表的一篇论文研究了1988年至2006年期间美国的数据，发现在某家银行设有分支机构的地区，如果房价上涨一个标准差，从该银行借贷的公司获得的放贷增长就减少42%。受影响公司的总投资下降21%。考虑到一众发达国家的银行大幅增加了房贷，这种挤出效应在其他地方可能也相当显著。在17个发达经济体中，房贷在银行贷款总额中的份额从1952年的32%攀升至2016年（有数据可查的最新年份）的58%。

无论高地价在西方的影响如何，这个问题在中国的影响似乎更大，毕竟中国投资者格外热衷房地产。近年的一系列研究表明，中国的高地价导致银行贷款从没有太多地产的制造企业流出，也使得上市公司的研发支出减少，此外似乎还导致了管理人才更多流向房地产行业。日内瓦大学的哈拉尔德·豪（Harald Hau）和北京对外经济贸易大学的欧阳涤非在2019年发表的一篇论文得出了尤其惊人的结果。根据中国172个城市的制造企业数据，该研究发现房价上涨50%会提高借贷成本、降低投资和生产率，导致企业的附加价值产出下降35.5%。

| 切中要害

高企且不断上涨的房价可能抑制经济活动，这一结论对政策制定者应如何对待土地和住房投资具有重要意义。例如，大力鼓励房屋建设将有助于降低抵押品的价值。限制可拥有的房产数量会改变抵押品的分配。同时，限制银行的按揭放贷可能会使更多信贷流向生产性用途。

一个更雄心勃勃的想法是对土地价值征税，这可以降低土地的市场价值，进而可能会降低其作为抵押品的吸引力。有趣的是，这种税正是18和19世纪许多改革者争取社会平等时的目标。重新痴迷土地很可能会让一个旧的主张再度兴起。■



Bartleby

Why it's OK not to be perfect at work

A backlash against the tyranny of high expectations

IT IS THE world's most tired interview question: what is your greatest weakness? And Rishi Sunak, one of the two remaining candidates in the race to become Britain's prime minister, gave the world's most tired answer—perfectionism—when he was asked it at an online hustings earlier last month.

No interviewee would answer this question with an unambiguous negative (“stupidity”, say, or “body odour”). Like all those who have reached for it before, Mr Sunak will have intended his reply to signal that his flaws are virtues, especially compared with the shambolic style of Boris Johnson's outgoing government.

But this classic response is riskier than it once was. In Mr Sunak's case that is because the job of prime minister is largely to triage problems and make decisions at a relentless pace; even his supporters worry that his deliberative style would be a problem. More generally, perfectionism is increasingly out of step with the ways that products are developed, employees are treated and workforces are organised.

Start with product development. Lots of digital types embrace the concept of the minimum viable product (MVP), in which companies ship prototypes that can be refined, or indeed scrapped, on the basis of feedback from early adopters. The essence of the MVP approach is anti-perfectionism: don't procrastinate, don't spend time sweating the tiniest details, get your product into users' hands and see how it does. Fussing about font sizes and nice-to-have features is a waste of time; the market will hone things for you, dispensing its judgments cumulatively and

dispassionately.

A growing emphasis on employees' well-being is another reason why perfectionism is out of favour. The trait is on the rise: a study published in 2017 found that it had been steadily increasing among American, British and Canadian college students between 1989 and 2016 (before you blame Instagram, one big reason is rising parental expectations). The tyranny of excessively high expectations is not good for you: a big literature review in 2016 concluded that perfectionism is associated with a string of mental-health disorders, from depression and burnout to stress and self-harm.

It matters what kind of perfectionist someone is. Psychologists distinguish between a “self-oriented” version, in which people put pressure on themselves to perform flawlessly; an “other-oriented” type, in which people hold their colleagues to the highest of standards; and a “socially prescribed” version, in which employees think that they will only get on if they meet the impossible expectations of those around them. People in the last camp seem to be especially prone to stress. A recent Italian study found that, whereas having extremely high standards for your own performance was not a predictor of burnout, being afraid of making mistakes was.

Perfectionists may also hurt team cohesiveness. In a study conducted in 2020, Emily Kleszewski and Kathleen Otto of Philipps-University of Marburg asked people to rate potential co-workers based on descriptions of their levels and categories of perfectionism. Perfectionists were regarded as being less socially skilled and less likeable than non-perfectionists. You don't have to like your colleagues for them to be effective: in that same study, perfectionists were rated as more competent than non-perfectionists. But when more and more work is organised around small groups working together, it can help not to loathe each other.

By now your inner curmudgeon may well be frothing at the mouth. Nit-

picking micro-managers are deeply annoying but they are nowhere near as bad as people who don't have any standards. Demanding bosses can be the difference between good products and superb ones: "that'll do" was not the mantra that made Steve Jobs successful. Some jobs actively require perfectionism—copy editors, say, or medicines regulators. And since when did being exacting become a health risk?

Fortunately, discouraging perfectionism does not mean sacrificing high standards. In a paper published last year, three academics at the University of Ottawa found that people who strove for excellence did better on tests of creative thinking than people who sought perfection. Managers can explicitly define what counts as high-quality work. Deadlines can prevent endless procrastination. Mr Sunak's call not to let the perfect be the enemy of the good came as he sat in front of a poster that misspelled the word "campaign". That took things too far. ■



巴托比

为何工作不求完美也OK

反抗高期望的暴政

世界上最令人生厌的面试问题是：你最大的缺点是什么？上月早些时候，竞选英国首相的最后两名候选人之一里希·苏纳克（Rishi Sunak）在一次线上竞选活动中被问到了这个问题，而他给出了世界上最令人生厌的答案——完美主义。

没有哪个受访者会就这个问题给出明确是负面的答案（比如“愚蠢”或“有体味”）。正如此前所有奋力抓住了这个完美答案的人一样，苏纳克想要用它传达出自己的缺点就是优点，尤其要与即将下台的约翰逊政府的混乱作风形成对比。

但是，这个经典的回答如今已经不那么保险了。就苏纳克而言，这是因为首相的工作主要是对问题划分轻重缓急，并毫不迟疑地做出决定；甚至连他的支持者也担心他的审慎作风会是个问题。更广泛来说，完美主义与开发产品、对待员工及组织劳动力的方式越来越不合拍了。

首先看产品开发。许多数字化公司都信奉MVP（最小可行产品）的概念，即公司直接发售产品原型，然后根据早期使用者的反馈做改进，或者直接放弃。MVP方法的本质是反完美主义：不要拖延，不要花时间琢磨细枝末节，先把产品送到用户手中，看看效果如何。纠结字体大小和锦上添花的功能都是在浪费时间，因为市场会为你打磨产品，渐进而冷静地给出它的判断。

日益重视员工福祉是完美主义失宠的另一个原因。人群的完美主义倾向在加重：2017年发表的一项研究发现，在1989至2016年间，在美国、英国和加拿大的大学生中这种倾向稳步上升（你可以怪在Instagram头上，但很大的原因是父母的期望值越来越高）。受高期望的支配不是件好事：2016年的一份长篇文献综述认为，完美主义与一系列心理健康障碍有关，包括

抑郁、倦怠、压力和自残等。

一个人属于什么类型的完美主义也很重要。心理学家将之区分为“自我导向”型，即对自己施加压力，力求表现得完美无缺；“他人导向”型，即以最高标准要求自己的同事；还有“社会导向”型，即员工认为必须满足周围的人对自己不切实际的过高期许。最后一类人似乎特别容易产生压力。意大利最近一项研究发现，极高的自我要求未必会导致精疲力竭，但害怕犯错却会。

完美主义者也可能损害团队凝聚力。2020年的一项研究中，马尔堡大学（Philipps-University of Marburg）的艾米丽·克拉舍夫斯基（Emily Kleszewski）和凯瑟琳·奥托（Kathleen Otto）让人们根据对假设的同事完美主义的程度和类别描述来给他们打分。与非完美主义者相比，受访者认为完美主义者的社交能力较差，也不那么讨人喜欢。但你的同事并不一定要讨人喜欢才能有效工作：在同一项研究中，受访者评价完美主义者比非完美主义者更有能力。但是，现在越来越多的工作是由小型团队来共同完成的，成员之间彼此厌恶总归无益。

讲到这里，你内心的怒气很可能已经要喷涌而出了。吹毛求疵的微观管理者固然令人恼火，但毫无标准的人要糟糕百倍。一个要求严苛的老板可能就是优秀产品与杰出产品的区别所在：“就这样吧”可不是让乔布斯成功的口头禅。有些工作确实需要完美主义——比如文字编辑，或者药品监管者。还有，严格要求什么时候都能危及健康了？

所幸，淡化完美主义并不意味着牺牲高标准。在去年发表的一篇论文中，渥太华大学的三位学者发现，追求卓越的人在创造性思维测试中的表现优于追求完美的人。管理者可以明确界定什么才算高质量的工作。设定最后期限可以避免无休止的拖延。当苏纳克呼吁不要把完美和好对立起来时，他身后的海报把“campaign”一词拼错了。这就太过头了。■



Cloudburst

The era of big-tech exceptionalism may be over

America's technology giants are facing unfamiliar limits to growth

IN THE DIGITAL world, the laws of physics can be suspended on a programmer's whim. Equally, that world's corporate architects have seemed able to defy economic gravity. Since 2005 the digital share of American GDP has risen by a third, to 10%. America's tech oligopoly—Meta, Alphabet, Amazon, Microsoft and Apple (MAAMA, if you will)—has outpaced even that breakneck growth. Collectively, MAAMA's revenues and profits have swelled by nearly 20% a year on average over the past decade, while America eked out nominal annual GDP growth of less than 4%. Covid-19 may have cramped physical lives, but it enriched digital ones—thereby also enriching big tech as never before.

This year gravity has asserted itself once more. The tech-heavy NASDAQ index is down by a quarter since January, half as much again as America's broader stockmarket. Profitless not-so-big tech has been dragged down by anaemic revenue growth and high interest rates, which make the far-off earnings of firms like Snap look less valuable today. More surprising, despite generating piles of cash in the here and now, the giants are also feeling the tug of reality. On July 26th Alphabet reported its slowest quarterly sales growth since the bleak early months of the pandemic. Its share price rallied, though not enough to offset recent falls and only because expectations were even worse. A day later Meta said its sales fell year on year, for the first time ever.

America's technology titans are suddenly having to contend with forces that have long plagued old-economy CEOs: gummed-up supply chains, protectionism, worker shortages and competition. For MAAMA, these constraints are something of a novelty. Its bosses had better get used to

them.

One limit is geography, often forgotten in a world of seamless global supply chains and largely borderless cyberspace. In so far as the tech giants peddle physical bits and bobs rather than digital bytes, they are sharing in the pain of supply disruptions. In April, Apple (which like Amazon was due to report its results after we went to press) warned that its revenues would be \$4bn-8bn lower than expected in the second quarter, chiefly because of supply-chain snags in China, where factories are locked down with unnerving severity every time a case of covid turns up. Ingenious inventory-management software has not spared Amazon—which, like conventional retailers such as Walmart, misjudged what shoppers wanted and when—from extra costs.

Barriers are being put up on the internet, too, as places from the European Union to India become more protective of their citizens' data and of their own digital darlings. That is a worry for Alphabet, Meta and Microsoft, which, outside firewalled China at least, face few barriers to selling their digital services.

Another limit has to do with talent. Tech firms are not used to scrabbling around for the best programmers. However, having dislodged banks and consultancies as graduates' dream employers, big tech is finding it hard to recruit. One reason is the sheer size of MAAMA's collective workforce, which has grown nearly seven-fold in the past ten years, to 2.2m. The bigger the payroll the harder it is to replenish, let alone expand. Big tech also faces stiffer competition from other industries, all of which these days manifest a degree of techiness minus the controversies that have sullied big tech's reputation.

The last limit is MAAMA's markets. As businesses such as e-commerce revert to pre-covid growth rates, the pandemic looks less like the start of an

era of endless digitisation, and more like a one-off step-change. As they become commonplace, tech offerings are behaving like other staples. As Alphabet and Meta show, digital ads, once thought immune to the business cycle, may be turning as procyclical as the offline sort.

Be it online ads or shopping, the cloud or smartphones, tech markets are more mature—and mature markets grow more slowly, especially when regulators are no longer ignoring them. In many areas incumbents' fat margins are being competed down. Amazon, for example, is investing heavily in its advertising business, Alphabet's forte; Alphabet, meanwhile, is spending billions to get a foothold in the cloud, which is Amazon's.

| *MAAMA mia, can you grow again?*

The giants of tech may yet rediscover their reality-distorting magic. Amazon's \$3.9bn purchase last month of One Medical, an American health-care provider, is only the latest MAAMA effort to conquer one of the last remaining under-digitised markets big enough to move the needle for a trillion-dollar firm. They may once again conjure up an all-new market, as Apple did with the iPhone's app economy and hopes to repeat with augmented reality. Until that happens, though, the era of big-tech exceptionalism is probably over. ■



【首文】风云突变

科技巨头例外论的时代可能结束了

美国的科技巨头正面临陌生的增长限制

在数字世界中，程序员一时兴起，就能让各种物理法则失效。同样，这个世界的企业建构师们似乎已经能够违抗经济重力了。自2005年以来，数字经济占美国GDP的比重增长了三分之一，达到10%。美国五大科技寡头——Meta、Alphabet、亚马逊、微软和苹果（可以姑且统称为MAAMA）的增速甚至还要快于已经很惊人的总体增长。整体而言，MAAMA的收入和利润在过去十年以平均每年近20%的速度增长，而美国的名义GDP年增长率却还不到4%。新冠疫情可能妨碍了人们的现实生活，却丰富了数字生活，从而也前所未有地“喂肥”了大型科技公司。

今年，重力法则再次发威。自1月以来，以科技股为主的纳斯达克指数下跌了四分之一，跌幅是美国整体市场的一倍半。那些尚未盈利、规模不是特别大的科技公司受到收入增长乏力和高利率的拖累，利率上升让Snap等公司的远期收益在今天看起来价值更低了。更令人惊讶的是，尽管眼下还在大赚特赚，巨头公司也感受到了现实强大的下拉力。7月26日，Alphabet公布了自疫情最初惨淡的几个月以来最缓慢的季度销售增长。尽管之后其股价有所反弹，但也不足以抵消最近的几次下跌，而且反弹也只是因为此前人们的预期数字还更糟糕。7月27日，Meta表示其销售额有史以来首次同比下降。

突然之间，美国的科技巨头们也必须对抗那些长期困扰传统经济部门的CEO们的因素：供应链阻滞、贸易保护主义、员工短缺和竞争。对于MAAMA来说，这些限制多少还算新鲜事。它们的老板最好能适应起来。

第一个制约因素是地理。在全球供应链无缝衔接、网络空间基本无边界的世界里，这个因素常常被忽略。只要科技巨头们还在卖各种小件实物，而不是数字世界里的字节，就一样会承受供应中断的痛苦。4月，苹果（与亚马逊一样，预计会在本刊付印后公布业绩）警告称自己第二季度的营收

将比预期少40至80亿美元，主要原因是供应链在中国的环节受阻——中国的工厂只要一出现新冠肺炎病例，就会采取令人不安的严厉封锁措施。拥有精妙的库存管理软件的亚马逊也没能避免成本增加——就像沃尔玛等传统零售商一样，它错估了顾客在何时想要买什么。

互联网上也在竖起各种壁垒——从欧盟到印度，各地采取了更多措施保护本国公民的数据和本国的数字宠儿。这对Alphabet、Meta和微软是个隐忧。目前它们在数字服务销售方面几乎没什么障碍——至少在有防火墙的中国以外是这样。

另一个制约与人才有关。科技公司并不习惯于四处搜罗最好的程序员。然而，尽管已经取代银行和咨询公司成为毕业生的理想雇主，科技巨头现在发现很难招到人。原因之一是MAAMA巨大的总雇员规模，在过去十年中增长了近六倍，达到220万人。员工数量越多，就越难更新补充，更不用说扩大规模了。此外，巨头们还面临来自其他行业更激烈的竞争——这些行业如今全都有些科技成分，却没有那些让巨头声誉受损的争议。

最后一个制约是MAAMA的市场。随着电子商务等行业回落到新冠疫情前的增长速度，这场疫情看起来不太像一个无限数字化时代的开始，而更像一场一次性的跃进。随着科技产品变得司空见惯，它们的市场表现也和其他基本用品无异。正如Alphabet和Meta所示，曾经被认为不受商业周期影响的数字广告可能也会像线下广告那样，成为顺周期行业。

无论是在线广告还是网上购物、云服务还是智能手机，每个科技市场都已更加成熟——而成熟市场的增速会变慢，尤其是当监管机构不再无视它们之后。在许多领域，现有企业的丰厚利润正在因竞争被压低。例如，亚马逊正在大力投资自己的广告业务，这个市场是Alphabet的强项；与此同时，Alphabet正在斥巨资打入云计算领域，这个市场目前由亚马逊主导。

| MAAMA咪呀，你能再长吗？

科技巨头们也可能会重新发现自己的现实扭曲力场。亚马逊上月以39亿美元收购了美国医疗服务供应商One Medical。这宗收购只是MAAMA的最新

行动，要在所剩无几的数字化程度还不高、规模足以给一家万亿美元级公司带来明显变化的市场中再下一城。它们可能会魔术般地再创建一个全新的市场，正如苹果当初用iPhone创造了APP经济，而今又希望在增强现实技术领域再创辉煌一样。不过，除非它们能实现如此佳绩，否则科技巨头例外论的时代很可能已经结束了。■



Coming in to land

Why it is too early to say the world economy is in recession

Growth in the rich world is slowing, but has not crashed to a halt

EVERYONE IS A pessimist these days. On July 14th Steven Blitz of TS Lombard, an investment-research firm, said that he was now expecting a recession this year in the world's largest economy, a day after Bank of America made the same call. Goldman Sachs, another bank, expects GDP in the euro zone to fall in both the third and fourth quarters of the year. Americans' Google searches for "recession" have never been so high. Traders are selling copper (a proxy for industrial health), buying the dollar (a sign that they are nervous) and pricing in interest-rate cuts in 2023.

A number of factors have combined to create a toxic mixture. In response to the covid-19 pandemic America overstimulated its economy, provoking inflation not just within its borders but beyond them, as consumers' voracious demand for goods bunged up the world's supply chains. China's attempts to stamp out covid compounded these problems. Then Russia's invasion of Ukraine caused commodity prices to soar. In response to the ensuing inflation, roughly four-fifths of central banks worldwide have raised interest rates, by an average of 1.5 percentage points. After a meeting that ended on July 27th, the Federal Reserve raised rates for the fourth time this cycle, by three-quarters of a point.

At the root of recession worries is a fear of the consequences of monetary tightening. It is clear that central banks have to take the proverbial punchbowl away from the party. Wage growth in the rich world is far too strong given weak productivity growth. Inflation is too high. But the risk is that higher rates will end the party altogether, rather than making it less raucous. History is not encouraging in this regard. Since 1955 there have been three periods when rates in America rose as much as they are

expected to this year: in 1973, 1979 and 1981. In each case a recession followed within six months.

Has recession struck again? Rich-world economies, which account for 60% of global GDP, have certainly slowed since the heady days of mid-2021, when covid restrictions were being lifted. Goldman Sachs produces a “current activity indicator”, a high-frequency measure of economic health based on a range of indicators. The gauge has slowed in recent weeks (see chart 1). Surveys of factory bosses in America and the euro zone by S&P Global, a data provider, suggest that manufacturers are gloomier than at any time since the early days of the pandemic.

It looks too soon, though, to declare a recession—even if, as some expect, statisticians reveal after we go to press on July 28th that between April and June American GDP contracted for the second quarter running. This would count as a recession by one rule of thumb, but not necessarily by others. A series of oddities led GDP to shrink in the first quarter, even though the underlying performance of the economy was strong. It would also be too soon for Fed tightening to have had an effect.

Most economists look to America’s National Bureau of Economic Research (NBER) to find out if the economy is truly in recession. Its business-cycle-dating committee considers indicators beyond GDP in making that judgment, including jobs numbers and industrial production. The Economist has used a similar approach, with a little guesswork, for the rich world as a whole. Many indicators still point to expansion (see chart 2). It is hard to argue that a recession has arrived.

Yet with growth clearly slowing, the big question is how bad things will get. The few remaining optimists point to the strength of households and firms. The public is even gloomier about the economy than it was during the depths of both the global financial crisis and the pandemic (see chart 3). But

households in the rich world probably still have some \$3trn or so in “excess” savings accumulated during the pandemic. In America the cash balances of poor households were 70% higher in March than they were in 2019, according to the JPMorgan Chase Institute, a bank-affiliated think-tank.

Moreover, people seem more confident about their personal finances than about the state of the economy. Across the EU households are about one-third more likely to be positive about their own finances than they have been, on average, since the data began in the mid-1980s. In America an unusually low share of people believe they will be unable to meet debt commitments over the next three months. Consumer-spending trackers, including from the Bank of England (for Britain) and JPMorgan Chase (for America), still look fairly strong.

Governments are also handing out money to help poorer people cope with roaring energy prices. In the euro zone, governments are stimulating the economy by the equivalent of about 1% of GDP. Britain has offered handouts to poor households. In May the Institute for Fiscal Studies, a think-tank, reckoned that such spending would largely compensate the poorest households for the rising cost of living (though retail energy prices are now likely to rise further still).

The behaviour of businesses is also reassuring. Across rich economies the number of job vacancies is still near a record high. In Australia they are more than twice their pre-pandemic level, according to data from Indeed, a hiring website. In America there are more than two open positions for every unemployed person.

As a result, labour markets remain tight. You can find some evidence of rising joblessness in the Czech Republic, if you squint. Overall, though, the unemployment rate across the OECD club of mostly rich countries is lower

now than it was just before the pandemic. In half of OECD countries the share of working-age people who are in a job—a broader measure of labour-market health—is at an all-time high. If history is any guide, these figures are inconsistent with a looming recession.

| *Fear, uncertainty and doubt*

Declines in investment have in the past played a big role in downturns. In recessionary periods since the 1980s for the G7 group of large economies, around half the fall in combined GDP in negative quarters came from shrinking capital spending. This time investment data have weakened, but not catastrophically so, according to data compiled by JPMorgan for America, the euro zone and Japan.

Until recently capital spending was booming, as firms spent big on remote-working technology and reinforced supply chains. Now some believe they have overinvested in capacity. Others want to conserve cash. An analysis of survey evidence, credit conditions and corporate liquidity by Oxford Economics, a consultancy, suggests that investment in the G7 could decline at an annualised pace of around 0.5% in the second half of this year. That is not good, but it is not enough to create a recession by itself. The investment declines in past downturns were steeper.

Unfortunately there is a limit to the confidence that can be taken from good economic data when the fundamental fear of investors is monetary tightening. News of any kind, it seems, can convey bad news about a recession. Weak figures confirm that a downturn is approaching. Strong data, including wage rises, suggest central banks are not succeeding in slowing things down, requiring further tightening, which in turn stands to provoke a recession. Only signs that inflation is falling will truly dispel fears of a downturn.

There is some relief ahead. A gauge of supply-chain snarls compiled by the

New York Fed, comprising global transport costs, among other things, has eased. American petrol prices are now falling by 3% a week. Alternative Macro Signals, a consultancy, constructs a “news inflation pressure index”, which indicates whether the flow of news articles suggests price pressures are building up. The indices for America and Britain have fallen of late.

But hopes for a rapid fall in inflation are almost certain to be dashed. Past increases in the price of food and energy have not yet fully filtered into headline inflation rates: Morgan Stanley reckons that rich-world inflation will peak at 8% in the third quarter of 2022. Growth in wages shows little sign of easing. In earnings calls companies still talk about how best to pass on higher costs to their customers.

The mass of data confronting economists is useful, but an old lesson may still hold: that recessions are hard to spot in real time. The NBER dates the start of America’s downturn associated with the global financial crisis to December 2007. Even in August 2008 the Fed’s staff thought the economy was still growing at an annual pace of about 2%. The post-lockdown picture is particularly difficult to interpret. Barely anyone thought labour shortages would emerge last year, or that inflation would go from bad to worse in 2022.

That is the case for pessimism. The case for optimism is that the present episode of monetary tightening has only just begun. Before it bites there is time for a volatile world economy to deliver more surprises—perhaps even positive ones. ■



准备着陆

为何说世界经济陷入衰退言之过早

富裕国家增长放缓，但并未骤然停滞

这些天，人人都是悲观主义者。7月14日，投资研究公司TS Lombard的史蒂文·布利茨（Steven Blitz）说他预计全球第一大经济体今年将陷入衰退，在这前一天，美国银行发出了同样的警示。另一家银行高盛预计，欧元区今年第三、四季度的GDP都将下滑。在美国，谷歌上搜索“衰退”的次数达历史新高。交易员纷纷抛售铜（工业健康指标），买入美元（表明他们很紧张），并在定价中计入了对2023年降息的预期。

多重因素的叠加带来了麻烦。为应对新冠疫情的影响，美国过度刺激经济，结果消费者对商品的需求猛增，导致全球供应链堵塞，不止在美国国内引发通胀，还波及国外。中国的清零防疫措施令这些问题愈加复杂。而后俄罗斯入侵乌克兰又导致大宗商品价格飙升。为应对随之而来的通胀，全球约五分之四的央行都实施了加息，平均上调了1.5个百分点。美联储在7月27日会议后再次宣布加息75个基点，是本轮加息周期内的第四次。

担心经济衰退，从根本上说是忧惧货币紧缩的后果。很明显，各国央行已经必须要“从派对上撤走酒杯”了。相对于生产率增长的疲软，目前富裕国家的工资增长实在过于强劲。通胀过高了。但风险是升息会让整个派对戛然而止，而不是让它不要那么喧闹。这方面的历史并不叫人乐观。自1955年以来，美国有三个时期的加息幅度与今年预期相同：1973年、1979年和1981年。每次都是在六个月内发生了衰退。

衰退再次到来了吗？2021年中开始陆续解除新冠限制措施后，GDP占全球60%的富裕国家迎来了一波复苏。与那时的振奋相比，经济增长显然已经放缓。高盛构建的“当前活动指标”（根据一系列指标对经济健康状况做高频测量）最近几周呈下行走势（见图表1）。数据供应商标普全球（S&P Global）对美国 and 欧元区工厂老板的调研显示，目前制造商的信心跌至疫情暴发以来的最低点。

不过，即使真如一些人预期的，在7月28日本刊付印后发布的官方统计显示4至6月间美国GDP连续第二个季度收缩，现在就认定衰退已至似乎还是为时过早。根据一种经验法则这算衰退，但根据其他的衡量方法就不一定了。一连串非常事件导致了美国第一季度GDP萎缩，尽管经济基本面强劲。美联储紧缩措施的影响也不会那么快就显现。

大多数经济学家参考美国国家经济研究局（以下简称NBER）的衡量方式来判断经济是否真的陷入衰退。NBER的商业周期测定委员会在做判断时除了考虑GDP，还纳入就业岗位数量和工业生产等指标。本刊也采用了类似的方法（加上些许猜测）来评估富裕国家的整体情况。许多指标依然显示经济在扩张（见图表2）。很难说经济衰退已经到来。

不过，随着增长明显放缓，现在的一大问题是：情况会糟糕到什么地步？所剩无几的乐观主义者指出，家庭和企业的状况不错。目前，公众对经济前景的忧虑之深，比在全球金融危机和新冠疫情最严重时更甚（见图表3）。但富裕国家的家庭可能仍有约三万亿美元在疫情期间积累的“多余”储蓄。摩根大通的智库摩根大通研究所（JPMorgan Chase Institute）的数据显示，在美国，今年3月时贫困家庭的现金余额比2019年时高70%。

此外，相较于整体经济状况，人们对个人财务状况似乎更有信心。在整个欧盟，家庭对自身财务状况表示乐观的可能性比1980年代中期开始有数据以来的平均值高三分之一。在美国，认为自己未来三个月内无法偿债的人口比例大大低于平常水平。追踪消费者支出的指标——包括英国央行（衡量英国）和摩根大通（衡量美国）的指标——看起来也相当强劲。

各国政府也在发放资金帮助穷人应对能源价格飙升。在欧元区，各国政府正在以相当于GDP的1%左右的力度刺激经济。英国也向贫困家庭提供援助。智库财政研究所（Institute for Fiscal Studies）在5月估计，这类支出将在很大程度上帮助最贫困的家庭弥补生活成本的上涨（尽管目前看来能源零售价格应该还会继续上涨）。

企业的行为也令人安心。富裕经济体内的职位空缺数量仍接近历史高位。

招聘网站Indeed的数据显示，澳大利亚目前的职位空缺数量是疫情前的两倍多。在美国，平均每一名失业者对应两个以上的职位空缺。

因此劳动力市场依旧吃紧。如果仔细看，你可能看到证据显示捷克的失业率在上升。但总体而言，在成员国主要为富裕国家的经合组织（OECD）内，失业率要低于疫情前夕。在半数成员国中，劳动年龄人口的在职比例（衡量劳动力市场健康度的宏观指标）处于历史高位。如果从历史经验看，这些数字和衰退逼近是相矛盾的。

| 恐惧、变数、怀疑

在以往的衰退中，投资疲软是一大因素。就由大型经济体组成的七国集团而言，自上世纪80年代以来的历次经济衰退中，在季度整体GDP录得负增长时，约一半的跌幅要归咎于资本支出缩减。根据摩根大通编制的美国、欧元区和日本的数据，这一次虽然投资数字已经走弱，但还不是灾难性暴减。

由于企业大笔投资提升远程办公技术和加固供应链，直到最近，资本支出仍显得红红火火。现在有些公司觉得自己在产能上过度投资了，有些则想持有现金。咨询公司牛津经济研究院（Oxford Economics）对调研证据、信贷状况和企业流动性的分析表明，今年下半年七国集团的投资可能录得约0.5%的年化降幅。这并非好事，可是单单这样还不足以造成经济衰退。在过去的衰退中，投资下滑要更剧烈。

可惜，当投资者的根本担忧是货币紧缩政策时，良好的经济数据能给予的信心是有限的。任何形式的新闻似乎都能传递出有关衰退的坏消息。数据疲软证实经济正走向衰退。数据强劲（包括工资上涨）则表明央行没有成功为经济减速，因而需要进一步紧缩，而这又势必引发衰退。只有通胀有回落的迹象才会真正消除对经济衰退的忧虑。

接下来情况会有所缓解。纽约联储编制的用于衡量供应链堵塞压力的指数（考虑了全球运输成本等因素）已见松动。美国汽油价格现在每周下降3%。咨询公司另类宏观信号（Alternative Macro Signals）构建了一个“新

闻通胀压力指数”，从相关新闻报道的频率来透视价格压力是否在增加。英美两国的这一指数最近都已下降。

但通胀迅速回落的希望是几乎注定要落空的。食品和能源价格之前的升幅还没有完全体现在整体通胀中。据摩根士丹利估计，富裕国家的通胀率将在今年第三季度触顶，达到8%。工资增长基本不见放缓迹象。在财报电话会议上，各家公司仍在谈论如何充分把上升的成本转嫁给顾客。

摆在经济学家面前的大量数据是有用的，但有句老话也许仍然不假：经济衰退是很难实时发现的。据NBER判断，美国与全球金融危机关联的那轮衰退始于2007年12月。但即使在2008年8月，美联储官员仍认为经济在以每年约2%的速度增长。疫情解封后的情况尤其难以解释。几乎没有人想得到去年会出现劳动力短缺的问题，或者预见到通胀会在2022年进一步恶化。

这是悲观的理由。而值得乐观的是，目前这轮货币紧缩才刚刚开始。在其影响显现之前，动荡的世界经济还有时间带来更多惊讶，甚至可能是惊喜。 ■



The Economist Film

Interest rates and central banks - Part 1

When central banks raise interest rates, the impact is felt far and wide. So why do central banks do it?



经济学人视频

利率与央行（上）

央行提高利率的经济影响深远，它们为何这么做？



The vision thing

Henry Kissinger explains what he thinks makes great leadership

His study of six leaders from the 20th century is partial but enlightening

Leadership. By Henry Kissinger. Penguin Press; 528 pages; \$36. Allen Lane; £25

Whatever you think of Henry Kissinger, the 99-year-old former national security adviser and secretary of state in the Nixon and Ford administrations has an elephantine memory and experience that makes it an important historical resource. In his latest book, Mr Kissinger, an unofficial adviser and friend to many presidents and prime ministers, considers how six leaders from the second half of the 20th century reoriented their countries and made a lasting impact on the world.

Mr Kissinger's six are an eclectic bunch. Konrad Adenauer was the first post-war chancellor of West Germany. Charles de Gaulle saved France twice, first during the second world war, then at the time of the Algerian crisis. The author's old boss, Richard Nixon, shook geopolitics with his opening to China before scandal brought him down. Anwar Sadat paid with his life for forging a lasting peace with Israel as Egypt's president. Lee Kuan Yew made tiny Singapore one of the most prosperous places on Earth. And Margaret Thatcher reversed decades of British decline—while widening social and economic divisions—before being defenestrated by her party.

A project of this kind might have amounted to a series of brief eulogistic biographies of famous people. Much of the book will indeed be familiar to many readers—and at times the author's willingness to glide over inconvenient truths is distasteful. He justifies Nixon's covert bombing of Cambodia by the need to force the Vietnamese to negotiate. One of its consequences, the rise of the Khmers Rouges, merits a single sentence,

which blames Congress for cutting off military aid to the Cambodian government. (Watergate, too, is downplayed.) De Gaulle's extraordinary refusal to give credit to allies fighting and dying to liberate France nearly earns admiration. The controversy in which Thatcher almost revelled escapes all criticism.

The book is redeemed, and more, by the analytical framework in which each leader is examined, and by the author's personal knowledge of his subjects. Moreover, the writing is always crisp and lucid, even when conveying arcane theories of international relations, such as the notion of "equilibrium" that defined Nixon's foreign policy (and, by extension, Mr Kissinger's).

Having seen so many leaders at close hand, Mr Kissinger understands the constraints they must acknowledge and bypass. Among these are "scarcity", or the limits of their societies in terms of demography and economic heft; "temporality", or the prevailing values, habits and attitudes of their times; "competition" from other states that have their own goals; and the "fluidity" of events, the pace of which can force decisions to be made on the basis of intuition and hypothesis. Leaders must traverse a tightrope from which they fall if they are either too timid or too bold.

In Mr Kissinger's view, there are essentially two types of leader, the statesman and the prophet. Statesmen manipulate circumstances to their advantage, temper vision with wariness and work with the grain of societies until existing institutions need to be changed or confronted. Prophets are prepared, if not eager, to break with the past no matter the risk.

Five of his six leaders clearly belong more to one category or the other. Adenauer, Nixon and Thatcher had most of the characteristics of the author's complete statesman, although all three had a motivating vision.

Adenauer envisaged a humble Germany able to take its place among other liberal democracies. Nixon was committed to using America's economic and military might to bring the international system into a long-term equilibrium that would render war between great powers much less likely. Thatcher believed passionately in individual autonomy and the capacity for national renewal—if the energies of ordinary people could be freed by the magic of market economics.

By contrast, de Gaulle and Sadat were both driven by a prophetic ideal of what their countries could and should become. De Gaulle's feat of keeping the idea of the Free French alive when stranded in London in 1940 was an almost mystical triumph of will over reality. Sadat's belief that Egypt could never be independent and free without setting the terms of peaceful coexistence with Israel was rooted in a profound sense of his country's long history. Both could be pragmatic, but that was not their main *modus operandi*.

The perfect leader, thinks Mr Kissinger, combines elements of both archetypes. Of his six subjects, Lee may come closest, with his unflinching realism, ruthlessness (especially in tackling corruption) and unwavering vision of what a multi-ethnic community of Chinese, Indians and Malays, with few geographical advantages, could achieve. Singapore is far from being a liberal democracy—either Lee or his son have been prime minister for most of the city-state's existence. Mr Kissinger is not too fussed by that, but concedes that Singapore's ability to evolve from its founder's model will become essential to its continued success. The ultimate challenge will be to devise a better balance “between popular democracy and modified elitism”.

At the close, the author asks whether leaders are now emerging with “the character, intellect and hardiness required to meet the challenges facing world order”. He is not optimistic. The decline in erudition and the socially atomising effects of technology are unhelpful. So is the erosion of moral

purpose and the religious belief that often underpinned it, and which animated five of these six leaders (even Nixon was influenced by his Quaker upbringing).

Above all, Mr Kissinger writes, faith in the future is the indispensable quality for successful leaders and the “elevated purposes” they aim to inculcate. He ends with a warning: “No society can remain great if it loses faith in itself or if it systematically impugns its self-perception.” ■



远见卓识

亨利·基辛格阐述何为伟大领导力

他对20世纪六位领导人的研究虽嫌片面，却富启迪【《领导力》书评】

《领导力》。亨利·基辛格著。企鹅出版社；528页；36美元。Allen Lane出版社；25英镑。

无论你怎么看亨利·基辛格其人，他异常丰富的记忆和经历都足以构成一个重要的历史资源。现年99岁的他曾在尼克松和福特政府出任国家安全顾问和国务卿，也是许多总统和总理的非官方顾问和朋友。在他的最新著作中，他探讨了20世纪下半叶的六位领导人如何改变了自己国家的行进方向，也给世界留下了持久的影响。

基辛格选的六个人物可谓不拘一格。康拉德·阿登纳是战后联邦德国首任总理。戴高乐两次拯救了法国，先是在二战中，而后是在阿尔及利亚危机时期。作者的前老板尼克松因丑闻下台前，以他的对华开放政策撼动了地缘政治。埃及前总统萨达特为与以色列缔结持久和平关系付出了生命的代价。李光耀让弹丸之地新加坡崛起为地球上最繁荣的地方之一。撒切尔扭转了英国持续了几十年的衰落轨迹——同时也加剧了社会和经济割裂，之后被自己的政党抛弃。

这样的一本书写出来可能无非就是一套充满溢美之词的名人小传。本书的大部分内容确实会让许多读者感觉熟悉；有时作者把一些尴尬的事实含糊带过，令人反感。在他笔下，尼克松秘密轰炸柬埔寨是有理由的，因为需要迫使越南人走上谈判桌。此事件的一个后果是红色高棉的崛起，对此作者只提了一句——指责国会切断了对柬埔寨政府的军事援助。（水门事件同样被轻描淡写带过。）戴高乐拒绝感谢盟友为解放法国作战赴死，这奇怪的行为在作者这里近乎赢得了钦佩。对撒切尔几乎陶醉其中的争议没有任何指摘。

但本书依然值得一读，其亮点在它审视每个领导人的分析框架，以及作者

对这些人物的亲身了解。此外，作者的文笔从头至尾都清晰明了，哪怕是要介绍一些非常艰深晦涩的国际关系理论，例如定义尼克松外交政策（也就延伸为基辛格自己的）的“均势”理念。

近距离观察过这么多领导人后，基辛格理解他们必须承认和想办法绕过的各种限制。这包括“稀缺性”，即他们自己的社会在人口结构和经济实力方面的局限性；“时代性”，即他们生存的时代普遍的价值观、习俗和态度；来自别国的“竞争”，因为它们也有自己的目标；事件的“流动性”，也就是事件发生的速度之快可能迫使他们基于直觉和假设做出决策。领导人必须会走钢丝——太过胆小或胆大，都会跌下来。

在基辛格看来，领导人基本可以分为两类：政治家和预言者。政治家操纵环境使之于己有利，用警觉、谨慎来调和愿景，顺应社会惯例，直至现有制度需要被改变或挑战。预言者则准备好了——甚至于急切地——要和过去决裂，无论风险几何。

六位领导人中有五位都可以比较明显的划分到其中一类。阿登纳、尼克松和撒切尔具有作者所说的彻头彻尾的政治家的大多数特征，虽然三人也都怀有激励人心的愿景。阿登纳设想一个谦卑的德国能和其他自由民主国家平起平坐。尼克松致力于利用美国的经济和军事实力使国际体系进入长期的均势，从而大大降低大国之间爆发战争的可能性。撒切尔坚信个人自治以及——如果普通人的干劲可被市场经济的魔力解放——国家复兴的能力。

相比之下，戴高乐和萨达特都受一种预言式理想的驱使：自己的国家可以和应该变成什么模样。戴高乐1940年流亡伦敦时成功让“自由法国”运动延续下去，堪称意志战胜现实的神奇典范。萨达特相信如果不订立与以色列和平共处的条约，埃及就永远无法独立和自由，这是植根于对他自己国家悠久历史的深刻认知。两人也有务实的一面，但不是他们的主打风格。

在基辛格看来，完美的领导人是两个类型的结合体。在他的六个人物中，李光耀可能是最为接近的，因为他兼具坚定的现实主义、铁腕（尤其在反

腐上），以及对一个并没有什么地理优势的、由华裔、印度裔和马来裔组成的多民族社区的前途毫不动摇的希冀。新加坡远非自由民主制国家——这个城市国家独立建国后的大部分时间里都由李光耀或他的儿子担任总理。基辛格不是太过在意这一点，但他承认，新加坡从其开国元首的那套模式演进的能力将成为它持续成功的关键。最终的挑战将是在“大众民主和改良精英主义之间”找到更好的平衡。

在结尾处，作者问道，今天是否正在出现具有“应对世界秩序面临的挑战所必需的品格、智识和坚韧”的领导人。对此他并不乐观。学识的减退以及技术的社会原子化效应都没有助益。道德使命以及常常支撑它的宗教信仰的削弱也一样——而这些激励了六位领导人中的五位（即便尼克松也受到贵格会教育的影响）。

最重要的是，基辛格写道，对未来的信心是成功的领导人不可或缺的特质，对他们希望灌输给大众的“崇高目标”也一样重要。他以一句告诫收尾：“如果一个社会对它自己失去信心，或者系统性地质疑自我认知，它不可能继续伟大。”■



Free exchange

Should central banks' inflation targets be raised?

The last in our series on the central-bank pivot

When New Zealand's parliament decided in December 1989 on a 2% inflation target for the country's central bank, none of the lawmakers dissented, perhaps because they were keen to head home for the Christmas break. Rather than being the outcome of intense economic debate, the figure—which was the first formal target to be adopted by a central bank—owes its origin to an offhand remark by a former finance minister, who suggested that the soon-to-be-independent central bank should aim for either zero or 1% inflation. The central-bank chief and incumbent finance minister used that as a starting-point, before plumping for 0-2%. Over time, 2% became the standard across the rich world.

Should the somewhat arbitrary goal of 2% be changed? The question may seem a little churlish when central banks are so flagrantly missing their existing targets: annual inflation in America, Britain and the euro area, for instance, is running at around 9%. The Federal Reserve's experiment with "flexible average-inflation targeting" has coincided with the central bank allowing inflation to get out of hand. Yet it is possible that raising the target might help prevent rich countries from returning to the low-inflation, low-growth malaise that was the rule for the decade after the global financial crisis. The idea therefore warrants consideration.

High inflation is painful. Even if wages keep pace with price growth, thereby preserving workers' incomes in real terms, it undermines the function of money both as a unit of account and as a store of value. Contracts agreed at one point in time lose their worth rapidly, redistributing income and wealth arbitrarily between buyers and sellers or between creditors and debtors. Long-term investment and saving decisions

become more of a gamble, as the case of Turkey illustrates. Inflation there is in the region of 80%.

Yet deflation carries its own costs, too. Worryingly for mortgage-holders and governments alike, it raises the value of debts in real terms, which can generate a self-sustaining depression as incomes keep falling relative to debt payments. That explains why central banks aim for a low but positive rate of inflation.

Deciding which low but positive number is desirable is trickier. Is a target of 2% actually superior to one of 3% or 4%, for instance, or does it merely owe its exalted status to tradition? The relative damage done by extremely high or accelerating price growth may be easily visible, but economists have struggled to identify differences in the costs to an economy from different stable, low-single-digit inflation rates. The 20-year period of very low inflation that recently came to an end brought no positive leap forward in productivity nor any change in savings behaviour, except in reaction to the global financial crisis, points out Adam Posen of the Peterson Institute for International Economics, a think-tank in Washington.

If the costs of a slightly higher inflation target are small, the benefits are potentially sizeable. Chiefly, it could help central bankers avoid the so-called zero lower bound on nominal interest rates. Interest rates cannot go too far into negative territory, because they risk destabilising the banking system: depositors could always choose to empty their bank accounts and hold cash, which in effect carries an interest rate of zero, instead. That also limits the efficacy of negative interest rates. After the financial crisis some central banks set slightly negative rates on commercial banks' reserves, but lenders had little ability to pass them on to their retail clients. The impotence of negative interest rates encouraged central banks to adopt unconventional policies, such as quantitative easing.

Higher inflation targets are a different solution to the problem of the lower bound. If the public expects the central bank to generate more inflation in future then the interest rate, in real terms, can still be sharply negative, stimulating the economy even without nominal interest rates needing to venture below zero. Allowing moderately higher inflation in normal times could therefore make it easier for the central bank to give a boost to the economy when trouble hits.

The opportunity to escape the lower bound on interest rates is no small thing. The current spell of monetary-policy tightening notwithstanding, the risk remains that interest rates will stay relatively low. The long-term factors that were weighing on interest rates before the pandemic, such as an ageing population and low productivity growth, are still in place. There may be a benefit in the short term, too, to raising targets now. Reducing stubbornly high inflation requires cooling the economy, which generally involves raising the unemployment rate. The lower the inflation target, the more unemployment central banks need to generate to get there. If the costs of inflation at 3% really are not much different from inflation at 2%, central banks will be generating additional unemployment for little benefit.

| *Seizing the inflationary moment*

Set against this, however, are the consequences of renegeing on a 30-year promise. The experience of the past year has made clear that the public detests inflation; both finance ministries and central banks are being excoriated for losing control of price growth. To shift the goalposts now could give the impression of giving up the fight entirely. Inflation targeting was meant to anchor the public's expectations of price growth. Changing the target could undermine that objective altogether, by creating expectations that it will be raised again the next time inflation roars.

As long as inflation is so far off-target, such considerations seem likely to

stay the hand of any would-be monetary reformers. Yet once it peaks, restoring a degree of central banks' credibility, the pain of further disinflation, together with the promise of well and truly escaping the zero lower bound, could just start to make the idea of higher targets more alluring. ■



自由交流

央行是否应提高通胀目标？

央行策略转向系列末篇

一九八九年十二月，新西兰议会决议通过该国央行2%的通胀目标，没有一位议员表示反对，或许是因为他们都急着回家过圣诞假期。这是第一个由一国央行采用的正式通胀目标，它并非激烈经济辩论的结果，而是源自一位前财政部长随口说的一句话，他认为即将独立执行货币政策的新西兰央行应力求将通胀保持在零或1%。该行行长和时任财政部长以此为起点，后来选定了一个零至2%的目标区间。渐渐地，2%成了所有富裕国家的标准。

2%这个有点随意设定的目标是否应该改一改？在央行偏离既定目标十万八千里之时，提出这个问题似乎有些冒犯——比如目前美国、英国和欧元区的年通胀率都在9%左右。美联储允许通胀失控之时，正值它尝试“灵活的平均通胀目标制”。但是，提高通胀目标可能有助于防止富裕国家重回全球金融危机后的十年里低通胀、低增长的困境。因此，这个想法值得考虑。

高通胀是痛苦的。即使工资与价格增长保持同步，从而保住了工人的实际收入，也还是破坏了货币作为记账单位和价值储存手段的功能。在某个时间点达成的合同会迅速失去价值，在买卖双方或债权人和债务人之间随意重新分配了收入和财富。长期投资和储蓄决策变得更像是一场赌博，就像土耳其的情况一样。该国的通胀达到了80%左右。

但通缩也有代价。令抵押贷款持有者和政府都感到担忧的是，它提高了债务的实际价值，随着收入相对于偿债金额持续下降，这可能会导致一种自我持续的萧条。所以央行的通胀目标才会定在一个比较低的正值水平上。

要决定这个低正值该是多少就更棘手了。例如，2%的目标真的就比3%或4%更合理吗？还是说对这个数字的推崇仅仅是出于传统？通胀极高或加

速上涨所造成的相对损害可能很容易看出来，但不同的个位数的稳定通胀率在经济上的代价有何不同，经济学家一直难以搞清楚。华盛顿智库彼得森国际经济研究所（Peterson Institute for International Economics）的亚当·波森（Adam Posen）指出，于近些年结束的20年极低通胀期没有带来生产率的飞跃，也没有改变储蓄行为，除了在对全球金融危机做出反应时。

如果稍微提高通胀目标的代价很小，那么这么做的益处可能相当大。主要来说它可以帮助央行官员避免名义利率中所谓的零下限。利率进入负区间不能太多，因为这有可能会破坏银行体系的稳定性：储户随时可以选择清空银行账户，改为持有现金，如此利率实际上为零。这也限制了负利率的效力。金融危机后，一些央行对商业银行的准备金设定了轻微的负利率，但这些银行几乎没有能力将其转嫁给零售客户。负利率没有效果，促使央行采取了量化宽松等非常规政策。

更高的通胀目标是解决下限问题的另一种方式。如果公众预计央行未来会产生更多通胀，那么实际利率仍可能大幅处于负值，名义利率无需跌至零以下也能刺激经济。因此，在正常时期允许适度较高的通胀水平可以让央行在遇到麻烦时更容易提振经济。

能有机会摆脱利率下限可不是小事。尽管当前货币政策收紧，但利率仍有保持在相对较低水平的风险。人口老龄化和生产率增长低迷等疫情之前就影响利率的长期因素依然存在。现在提高通胀目标可能在短期内也有好处。降低顽固的高通胀需要冷却经济，这通常会推高失业率。通胀目标定得越低，央行要把通胀拉回到目标水平就会把失业率推得越高。如果3%的通胀与2%在代价上其实没太大差别，那么央行就是在导致更多失业，却换不来多少好处。

| 抓住通胀时机

然而有一个风险因素：违背一个许下30年之久的承诺带来的后果。过去一年的经验表明，公众厌恶通胀，财政部和央行都因失去对价格攀升的控制而受到斥责。现在改变通胀目标可能会给人一种放弃挣扎的感觉。通胀目

标制是为了锚定公众对价格上涨的预期。改变通胀目标会让人们认为当通胀再次飙升时，目标将再次提高，这样的预期可能会彻底破坏初衷。

只要通胀还是远远偏离目标，这样的顾虑似乎会让任何想要进行货币改革的人束手束脚。然而，一旦通胀水平达到顶峰，要恢复一些央行的信誉、需要更大力反通胀的痛苦，加之能完全摆脱零利率下限的希望，可能会开始让提高通胀目标的主意变得更加诱人。 ■



Less growth, more credibility

China's official growth figures are bad enough to be believed

We cross-check the latest numbers

WHEN CHINA'S Politburo, the 25-member committee that oversees the Communist Party, met this time last year to ponder the economy, China's rulers seemed quite confident. Their annual growth target was in easy reach and they were keen to crack down further on the country's overstretched property developers. As *The Economist* went to press, the Politburo was preparing to meet again. But the economy looks quite different. China's attempts to stamp out any outbreak of covid-19 have crippled manufacturing intermittently, and consumption more persistently. Distressed developers have stopped working on pre-sold flats—and aggrieved homebuyers have refused to pay their mortgages until construction resumes.

This has put China's rulers in a pickle. They seem determined to stick to their zero-covid policy. And they would no doubt love to cling to their official GDP growth target of “around 5.5%”. But it has become clear they cannot do both. Unless, of course, they fiddle the growth figures.

That is not beyond them. But there is so far little sign of it. The most recent data showed that the economy grew by only 0.4% in the second quarter, compared with a year earlier. This was not only bad, but worse than expected by private forecasters. In a large teleconference in May, Li Keqiang, China's prime minister, urged local officials to do more for the economy. But he also cautioned them to seek truth from facts, abiding by statistical regulations.

When he was himself a local official in the north-eastern province of Liaoning, Mr Li sought the truth about the provincial economy from three

facts in particular: the electricity it consumed, the cargo travelling on its railways and the amount of loans disbursed by its banks. These indicators, he felt, were more reliable than the official GDP figures. In a similar spirit, John Fernald, Eric Hsu and Mark Spiegel of the Federal Reserve Bank of San Francisco have shown that a judicious combination of eight alternative indicators (including electricity consumption, rail cargo, retail sales and consumer expectations) does a reasonably good job of tracking China's economic ups and downs. Seven of these indicators (all except consumer confidence) have already been updated for the three months from April to June. They can therefore be used to cross-check the latest official growth figure.

The chart shows our attempt to do that, using much the same method as Mr Fernald and his co-authors. Our calculation is not designed to show if China has systematically overstated GDP growth over the past two decades. But it can detect if reported growth is nearer its underlying trend than it should be, given how far the other seven indicators have strayed from their own usual trajectories. The awful data on retail sales and construction in the second quarter were, for example, far outside the norm. But these shocking figures were partly offset by respectable numbers for rail freight and exports.

In all, these indicators suggest the official growth measure was honest. (They would be consistent with GDP growth that is, if anything, a little higher than the 0.4% reported.) Our approach cannot reveal every kind of statistical skulduggery, but it does suggest China made no extra effort to fudge the figures in the second quarter, despite the unusual ugliness of the time. China's rulers want to fight the downturn, the virus and doubts about their country's data. They are doing a better job on the last two counts than on the first.

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更低增长率，更高可信度

中国的官方增长数字糟糕到足够可信

本刊校验了最新数据

去年此时，中共的25人最高领导委员会中共中央政治局开会讨论经济问题，当时中国的治理者似乎相当自信。他们的年增长目标触手可及，也积极地准备进一步打击过度扩张的房地产开发商。本刊付印时，中央政治局正准备再次召开会议。但当前的经济状态看起来已大不相同。中国试图扑灭一切新冠疫情苗头，致使制造业不时陷入瘫痪，消费更是持续疲软。房地产开发商深陷困境，在建预售楼宇停工，权益受损的业主拒绝继续还贷以求楼盘恢复施工。

这让中国的治理者进退维谷。他们似乎决意坚持清零政策。可他们无疑也很想要坚守“5.5%左右”的官方GDP增长目标。但显然无法两全。当然了，除非在增长数据上做手脚。

这并非做不到。但到目前为止没什么这样做的迹象。最新发布的数据显示，今年第二季度中国经济同比增长仅0.4%。这样的表现不仅是糟糕，而且比民间预测机构估计的还要差。在5月的一场大型电视电话会议上，总理李克强敦促地方官员加倍努力稳住经济，但也告诫官员们要遵守统计法规，坚持实事求是。

李克强曾在东北的辽宁省担任地方官员，当时他特别注意利用三个方面的数据来了解本省的实际经济情况：用电量、铁路货运量、银行发放的贷款额。他认为，这些指标比官方GDP数字更可靠。本着同样的精神，旧金山联储的约翰·弗纳尔德（John Fernald）、艾瑞克·徐（Eric Hsu）和马克·施皮格尔（Mark Spiegel）指出，审慎运用八个替代指标（包括用电量、铁路货运量、零售销售及消费者预期），可以较好地追踪中国的经济走势。其中（除消费者信心外的）七个指标的4月至6月数据已更新，可用于交叉校验官方最新发布的增长数字。

图表显示了本刊尝试校验的结果，所用方法与弗纳尔德及其合著者的基本相同。我们的计算不是要探究中国在过去20年里是否系统性地夸大了GDP增长。但它可以检测官方公布的增长率是否太过接近其基本趋势线，毕竟另七个指标远远偏离了各自的正常轨迹，例如第二季度零售销售和建筑业的数据惨不忍睹，远低于正常水平。但铁路货运和出口的数据尚可，部分抵消了前面那些数据的惊人下滑。

总的来说，这些指标表明官方增长数据是诚实的，它们显示的GPD增长甚至略高于官方的0.4%。我们的方法无法揭露所有的统计造假招数，但确实表明尽管中国二季度经济异常差劲，却没有特别费心伪造数据。中国的治理者想阻止经济下滑、抗击新冠病毒和反驳外界对中国官方数据的怀疑。他们在后两项上做得比前一项好。





Schumpeter

Watch Russia's Rosneft to see the new direction of global petropolitics

Oil's new eastern bloc

Igor Sechin is easy to caricature. The boss of Rosneft, Russia's state-owned oil giant, is a burly man with close-cropped hair whose pastime is making sausages, reputedly out of deer he himself has killed. He is one of President Vladimir Putin's most trusted henchmen. Since 2014, when Russia annexed Crimea, he has been blacklisted by America and this year, after Russia's invasion of Ukraine, the European Union put him on its sanctions list, too.

But he is no run-of-the-mill oligarch. The EU calls him "one of the most powerful members of the Russian political elite". As a Rosneft man through and through, he has stood up strongly for the country's oil-and-gas industry, which accounts for about 45% of the national budget. And he has a nose for geopolitics, which helps Rosneft shape and fund Mr Putin's despotic adventurism.

That is why it is worth watching state-controlled Rosneft and its boss to assess their response to the withdrawal of Western oil companies from Russia. On the one hand, the company faces reduced access to Western markets and has lost investment and expertise to help it develop oil- and gasfields in inhospitable parts of the country. On the other, it has benefited from a strategy masterminded long ago by Mr Sechin to pivot towards buoyant markets in China and India. The outcome will help determine whether the world is likely to split into two rival oil blocs.

The West's response to Russia's assault on Ukraine has hit Rosneft hard. Though high oil prices enabled it to pay a record annual dividend recently, an oil embargo has throttled its access to European buyers. Since February it has borne the lion's share of Russia's drop in oil output. Firms that once

cosied up to it now treat it as a pariah. BP, a supermajor, has written off its near-20% stake. ExxonMobil, another giant, is trying to pull out of the Sakhalin-1 oil-and-gas joint venture in Russia's far east. Rosneft's relationship with Western oil traders, who used to talk of a "pissing match" to win access to its treasure trove of crude shipments, has floundered. On July 13th a big trading firm, Trafigura, said it had unwound its 10% stake in Vostok Oil, a Rosneft megaproject in the tundra that Mr Sechin believes could sustain Russia for decades.

Pariah status affects Rosneft in subtler ways, too. Many of Russia's oilfields are ageing and require sophisticated techniques to squeeze out hard-to-recover crude at a reasonable cost. In the past the firm has had strong relationships with Western oilfield experts like Schlumberger, but these have pulled out of Russia. Moreover, sanctions have sent Rosneft's non-Russian board members and senior executives scurrying for safety, leaving a dearth of expertise in their absence.

Yet if anyone has seen this coming, it is Mr Sechin. Balancing Russia's dependence on Western oil markets with business in the east, especially China, has been part of his strategy since Mr Putin first handed him control of Rosneft in 2004. From the outset, says James Henderson of the Oxford Institute for Energy Studies, a think-tank, Mr Sechin saw China's commercial and strategic importance. He struck big oil-supply agreements with China National Petroleum Corporation (CNPC), Rosneft's state-owned Chinese counterpart, in exchange for vast prepayments and financing from China that helped turn the Russian firm into one of the world's largest listed oil companies. The payments helped Rosneft finance the takeover of the main oil-producing assets of Yukos, a Russian oil firm whose boss fell foul of Mr Putin in 2003, as well as TNK-BP, another rival Rosneft bought for \$55bn in 2013. In February, during Mr Putin's pre-war meeting with Xi Jinping, China's president, Rosneft signed another oil deal to supply crude to CNPC worth a whopping \$80bn over ten years.

Mr Sechin's India strategy has been quieter but also, as it turns out, shrewd. Rosneft used its part ownership of Nayara Energy, an Indian refiner, to gain a toehold in one of the world's fastest growing consumer markets. Indian refiners processed heavy crudes that Rosneft once brokered from sanctions-hit Venezuela, a staunch Russian ally in America's backyard. Now the refiners are reportedly keen to take discounted oil directly from Rosneft.

After the initial blow from sanctions, such relationships have enabled Russia swiftly to shift its oil exports east, eclipsing Saudi Arabia in May as the biggest supplier to China and raising oil sales to India from almost nothing to about 1m barrels a day—albeit at steeply discounted prices. Its resilience has caught many forecasters, including the International Energy Agency, by surprise.

| *Where there's a well there's a way*

In order to keep its performance up, Rosneft has to keep pumping and drilling. Yet its need for Western firms like Schlumberger to help it do that may be overstated. Matthew Hale of Rystad Energy, a consultancy, says the vast majority of Russian oil development is in onshore fields that, despite the cold, are easy to exploit. Last year Russian oilfield companies provided four-fifths of the services needed to support these investments. He says the ability of Russian firms to replace Western partners in complex projects is more open to question. That may delay their launch. But for the time being, Rosneft can continue to produce oil fairly freely.

It is not in the clear, though. If oil prices sink, its ability to drill wells profitably will be reduced. Constraints on Western capital, know-how and equipment may confound its attempts to develop big offshore liquefied-natural-gas projects in Russia's frozen far east, which it had once set its heart upon. Without access to Western financing, it becomes even more dependent on China, which always strikes a hard bargain. And next year a

full EU embargo on Russian oil will come into effect.

That said, the emerging eastern bloc should worry the West. Not only is an energy axis involving Russia, China and India a challenge for Western oil firms, it is also a threat to the climate—as Mr Sechin’s plans to develop Vostok suggest. He probably doesn’t give a sausage for such considerations, though. ■



熊彼特

关注俄罗斯石油公司，了解全球石油政治新方向

新兴石油东方集团

给伊戈尔·谢钦（Igor Sechin）画张漫画不难。俄罗斯国有巨头俄罗斯石油公司（Rosneft，以下简称俄油公司）的这位老板身形魁梧，头发剪得很短，把制作香肠当作消遣，据说用的还是他亲手捕杀的鹿。他是普京最信任的心腹之一。自2014年俄罗斯吞并克里米亚，他便被美国列入黑名单，今年俄罗斯入侵乌克兰后，欧盟也将他列入了制裁名单。

但他不是寻常的寡头。欧盟称他是“俄罗斯政治精英圈中最有权势的成员之一”。身为一名彻头彻尾的俄油人，他力挺占到国家预算约45%的俄罗斯油气产业。他对地缘政治也有敏锐的洞察力，这有助于俄油公司去影响和资助普京专横的冒险主义。

因此，值得密切留意国家控股的俄油公司及其老板，以评估他们对西方石油公司从俄罗斯撤出会作何反应。一方面，该公司进入西方市场的机会减少，还失去了协助自己在国内荒地开发油气田所需的投资和专业知​​识。另一方面，它得益于谢钦策划许久的一项战略：转向蓬勃发展的中国和印度市场。其结果将有助于确定世界是否有可能分裂为两个相互竞争的石油集团。

西方对俄罗斯袭击乌克兰的反应沉重打击了俄油公司。尽管近期的高油价让它支付了创纪录的年度派息，但石油禁运阻断了它与欧洲买家的接触。自2月以来，它承担了俄罗斯石油减产的最大份额。先前向它大献殷勤的公司现在对它退避三舍。超级巨头BP已脱手所持的近20%的俄油股份。另一家巨头埃克森美孚正试图退出俄罗斯远东地区的“萨哈林1号”（Sakhalin-1）油气合资项目。俄油公司与西方石油贸易商的关系陷入僵局，而它们过去还说要通过“撒尿比赛”来赢得打开俄油出口原油宝库的机会。7月13日，大型贸易公司托克（Trafigura）表示，它已出售在东方石油（Vostok Oil）10%的股份。这是俄油公司在苔原上的一个巨型项目，谢

钦认为它可以支撑俄罗斯几十年。

沦为贱民的新身份还以更微妙的方式影响着俄油公司。俄罗斯的许多油田都在老化，需要复杂先进的技术才能以合理的成本榨出难以开采的原油。过去，该公司与斯伦贝谢（Schlumberger）等西方油田专业公司关系很好，但它们已经撤出俄罗斯。此外，制裁促使公司的非俄罗斯董事和高管慌忙出走避险。他们这一走把专业知识也一道带走了。

然而，如果说有谁预见到会有这一天，那就是谢钦。自2004年普京首次将俄油公司的控制权交给他以来，平衡俄罗斯对西方石油市场的依赖与东方（尤其是中国）的业务一直是他战略的一部分。智库牛津能源研究所（Oxford Institute for Energy Studies）的詹姆斯·亨德森（James Henderson）说，谢钦从一开始就看到了中国在商业和战略上的重要性。他与中国国有石油巨头中石油达成了大型石油供应协议，来自中国的巨额预付款和融资助力它成为了世界上最大的上市石油公司之一。这些款项帮助俄油公司筹资收购了尤科斯（Yukos）的主要石油生产资产（这家俄罗斯公司的老板在2003年得罪了普京），以及在2013年以550亿美元收购了另一个竞争对手秋明-BP（TNK-BP）。今年2月，普京在战前与中国国家主席习近平会晤期间，俄油签署了另一项石油协议，在未来十年向中石油供应价值高达800亿美元的原油。

谢钦的印度战略要低调些，但事实证明同样是精明之举。俄油公司凭借对印度炼油商Nayara Energy的部分所有权，在这个全球增长最快的消费市场之一获得了立足点。公司先前充当中间商从遭受制裁的委内瑞拉（位于美国后院的坚定的俄罗斯盟友）获取重质原油，由印度的炼油厂加工。据报道，这些炼油商现在迫切想直接从俄油公司拿到打折石油。

在经受了制裁的初步打击后，这些关系使俄罗斯能迅速将石油出口转向东方，在5月超越沙特阿拉伯成为中国最大的石油供应国，并将对印度的石油销售从几乎为零提高到每天约100万桶——尽管价格大幅打折。这样的韧性让包括国际能源署在内的许多预测机构感到意外。

| 有油井就有门路

为了保持业绩，俄油公司必须持续开采和钻探。不过它对斯伦贝谢这样的西方公司的需要可能被夸大了。咨询公司雷斯塔能源公司（Rystad Energy）的马修·黑尔（Matthew Hale）表示，俄罗斯绝大部分石油开发都是在陆上油田，尽管天气寒冷，开采还算容易。去年，支持这些投资所需的服务有五分之四是俄罗斯的油田公司提供的。他说，俄罗斯公司是否有能力在复杂的项目中取代西方合作伙伴更成问题些。这可能会使它们的项目启动延期。但就目前而言，俄油公司可以继续相当自由地生产石油。

然而，它并不是就高枕无忧了。如果油价下跌，其石油开采的盈利能力就会被削弱。它曾经一心想在俄罗斯天寒地冻的远东地区开发大型海上液化天然气项目，但获取西方资本、技术和设备上的限制可能会令它的努力受挫。由于无法获得西方融资，它变得更加依赖中国，而中国在讨价还价时一向很强势。而且欧盟明年将对俄罗斯石油实施全面禁运。

尽管如此，这个新兴的东方集团应该令西方警觉。俄罗斯、中国和印度构成的能源轴心不仅对西方石油公司是个挑战，对气候也是个威胁——从谢钦开发东方石油的计划就可以看出来。不过，对于这类顾虑，他可能眼皮都不会抬一下。■



Class of 2022

What Gen-Z graduates want from their employers

More flexibility, more security—and more money

Generation Z is different. As a whole, Americans born between the late 1990s and early 2000s are less likely to have work or look for it: their labour-force-participation rate is 71%, compared with 75% for millennials (born between 1980 and the late 1990s) and 78% for Generation X (born in the decade or so to 1980) when each came of age. As a result, they make up a smaller share of the workforce. On the other hand, they are better educated: 66% of American Gen-Zs have at least some college (see chart 1). The trend is similar in other rich countries. With graduation ceremonies behind them, the latest batch of diploma-holders are entering the job market. What they want from employers is also not quite the same as in generations past. And as the economy sours following a pandemic jobs boom, those wants are in flux.

Start with their broad preferences. Although Gen-Z recruits felt more lonely and isolated than their older colleagues at the start of the pandemic, the ability to work remotely has unearthed new possibilities. The benefits go beyond working in your pyjamas. Many are taking calls from beach chairs and hammocks in more exotic locales or fleeing big cities in search for cheaper or larger homes.

In Microsoft's latest Work Trend Index, which polled more than 30,000 workers in 31 countries in January and February, more than half of Gen-Z hybrid workers said they were relocating thanks to remote work, compared with 38% of people overall. The option to work remotely is increasingly non-negotiable. Workers aged 18 to 34 are nearly 60% more willing to quit than their older peers if the choice is taken away, according to research by McKinsey, a consultancy. They are also more likely to engage with job

listings that mention flexibility.

This has big implications. Industries with jobs that cannot be done from home are falling out of favour with recent graduates. A study by ManpowerGroup, a recruitment company, suggests an inverse relationship between talent shortages and flexible working policies. The sectors which are either less able to offer remote work or have been slower to embrace it—including construction, finance, hospitality and manufacturing—have faced some of the biggest skills gaps for all types of job. The same is almost certainly true for their university-educated workers.

That in turn has accelerated a pre-existing trend of young recruits trading Wall Street for Silicon Valley. Ever since thousands of banking jobs were axed—and the industry's reputation tarnished—in the wake of the financial crisis of 2007-09, big tech has looked more attractive to graduates than big banks have. In Britain, the number of young people studying computer science rose by almost 50% between 2011 and 2020, to over 30,000. More than 31,000 took up an engineering course in 2020, up by 21% from 2011.

Now technology bosses are more willing than their opposite numbers in finance to let employees work from home (or anywhere else). Bank ceos such as Jamie Dimon of JPMorgan Chase or James Gorman of Morgan Stanley have urged employees back to the office. By contrast, Mark Zuckerberg has allowed workers at Meta, his social-media giant, to work from anywhere if their role allows it even after the firm reopened its American offices in March.

Annual rankings of employer desirability by Universum, a graduate-staffing consultancy, bear this out. In 2008 the list of best employers as graded by American graduates was dominated by big banks and the Big Four consulting firms (Deloitte, ey, KPMG and PwC). By 2021 seven of the ten highest spots were occupied by tech and media giants (see chart 2).

There are signs that Gen-Zs' love affair with tech may be losing some of its ardour. After a decade of frantic hiring, tech is suddenly looking like a less secure early-career bet for the ambitious graduate. Having taken a battering from nervy investors this year, companies such as Alphabet, Meta, Microsoft and Uber have slowed hiring. Twitter has revoked recently made job offers. Netflix has laid off hundreds of workers. So have newer tech darlings such as Coinbase and Robinhood. Elon Musk, Tesla's chief executive, has announced a hiring freeze and cuts of about a tenth of the electric-car maker's staff. More than 28,000 workers in America's tech sector have lost their jobs so far in 2022, according to Crunchbase, a data provider. Those graduates who do choose tech are likelier to pick an established firm over a sexy startup with hazier prospects.

| *Experimenting with drugs*

Some graduates may instead opt for other high-tech sectors that seem less vulnerable to economic swings. Drugmakers at the forefront of the covid-19-vaccine rollout are finding particular favour. AstraZeneca and Pfizer, each of which has produced an effective jab, shot up in the rankings of Britain's most attractive employers last year. AstraZeneca doubled its intake of high-school and university graduates in 2021. The war in Ukraine, meanwhile, may boost the appeal of armsmakers—shunned by some millennials and Gen-Xers as irredeemably unethical but now able to portray themselves as producers of the “arsenal of democracy”.

Graduates' sharpening focus on job security also boosts the appeal of the public sector, notes Dan Hawes, co-founder of Graduate Recruitment Bureau, a British firm. In Britain, applications for government jobs rose by nearly a third at the start of the pandemic. In March there were an estimated 67,000 more public-sector employees in the country than a year earlier. Around 1.4m Chinese vied for just over 31,000 government positions by sitting the notoriously tough national civil-service exam in

November 2021, up by more than 40% compared with the previous year.

If graduates keep gravitating towards safe government jobs, that will leave a smaller talent pool for private employers to fish in. Despite signs of a slowing economy, labour markets remain tight. Many older professionals quit their jobs during the pandemic. Others retired early.

Britain's labour force has lost more than 250,000 people since covid-19 first struck. America has 3.3m fewer people working. The latest official figures there show 11.3m job openings but only 6m unemployed Americans. It will take at least four years for the American labour market to return to its pre-pandemic employment rates, according to the OECD, a club of mostly rich countries.

How far will companies go to entice younger workers—and keep them happy? For the time being the short answer seems to be: quite far. To burnish its flexible-working credentials Citigroup, a bank, has opened a new hub in the Spanish coastal city of Málaga, luring over 3,000 applicants for just 30 analyst roles. In addition to providing gourmet meals, round-the-clock massages and nap pods, Google recently hired Lizzo, a pop star, to perform for staff.

The best thing firms can do to attract young talent is to cough up more money. According to Universum, some earlier Gen-Z hobby horses such as an employer's commitment to diversity and inclusion or corporate social responsibility have edged down the list of American graduates' priorities. A competitive base salary and high future earnings have edged up. Banks such as JPMorgan Chase, Goldman Sachs and Citigroup, and management consultancies including McKinsey and BCG have bumped first-year analysts' annual pay up to \$100,000. Law firms have been raising their starting salaries. bp, a British energy giant, offers recent graduates sign-on bonuses of as much as £5,000 (\$6,000) and discounts on cars. Money isn't

everything. But it's something.

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2022届

Z世代毕业生对雇主有哪些期望

工作更灵活、更稳定——薪资也要更高

Z世代与众不同。总体而言，出生于上世纪90年代末到本世纪初的美国人工作的概率或找工作的意愿相对较低：达到法定工作年龄时，Z世代的劳动参与率为71%，而千禧一代（出生于1980年到90年代末）为75%，X世代（出生于1980年前的十来年里）为78%。因此，Z世代在劳动人口中所占的比例较小。而另一方面，他们的受教育程度更高：美国66%的Z世代至少都接受过某种大学教育（见图表1）。其他富裕国家的趋势也类似。参加了毕业典礼之后，最新一批毕业生开始进入就业市场。他们对雇主的期望也与过去几代不太一样。而且随着经济在疫情期间岗位激增后又开始滑坡，这些期望也在不断变化。

先从他们的总体喜好说起。尽管在疫情初期，Z世代新员工比更年长的同事孤独隔绝之感更深，但远程工作的能力带来了新选择。其中的好处不光是可以穿着睡衣工作。许多人跑到异国他乡，躺在沙滩椅或吊床上接电话；或者逃离大城市，寻找更便宜或更大的房子。

今年1月和2月，微软调查31个国家的三万多名员工后，得出了最新的工作趋势指数（Work Trend Index）。它显示在混合办公的Z世代员工中，超过一半人表示他们正因为可以远程工作而搬家，而在所有混合办公人群中这一比例为38%。可以远程工作越来越成为一个必需项。根据咨询公司麦肯锡的研究，如果这种选择权被剥夺，18到34岁之间的员工的离职意愿比年长员工高出近60%。他们也更可能回应那些提到弹性工作的招聘启事。

这产生了重大影响。那些无法居家办公的行业正在失去应届毕业生的青睐。招聘公司万宝盛华（ManpowerGroup）的一项研究表明，人才短缺与弹性工作制之间存在反比关系。在一些难以实施弹性工作或者在这方面态度不够积极的行业，比如建筑、金融、招待服务和制造业等，所有类型的岗位都面临着一些最大的技能缺口。而这些行业里受过大学教育的员工

也几乎面临同样的技能缺口。

这继而又加快了一个既有趋势：年轻员工从华尔街转向硅谷。在2007至2009年金融危机后，成千上万的银行职位被裁掉，加上银行业声誉受损，大型科技公司对毕业生的吸引力似乎超过了大银行。在英国，2011年至2020年间，入读计算机科学的年轻人数量增长了近50%，达到三万多人。2020年，入读工科的人数超过3.1万，比2011年增长了21%。

现在，科技公司的老板们比金融业的老板们更愿意让员工在家（或其他任何地方）办公。摩根大通的杰米·戴蒙（Jamie Dimon）和摩根士丹利的詹姆斯·戈尔曼（James Gorman）等银行CEO敦促员工回到办公室去。相比之下，即便社交媒体巨头Meta已经在3月重新开放了美国办公室，老板马克·扎克伯格仍允许其员工在任何可以完成自己工作的地方办公。

毕业生招聘顾问公司优兴咨询（Universum）发布的年度雇主满意度排名反映了这种趋势。2008年，美国毕业生评选出的最佳雇主榜单被大银行和四大咨询公司（德勤、安永、毕马威和普华永道）霸榜。而到了2021年，前十个位次中有七个被科技公司和媒体巨头占据（见图表2）。

眼下有迹象表明，Z世代对科技公司的钟爱可能在消减。在持续十年的大举招兵买马之后，科技公司似乎突然之间不再是雄心勃勃的职场新人眼里非常稳妥的选择。今年，在神经紧张的投资者带来重创之后，Alphabet、Meta、微软和优步等公司放缓了招聘。推特还撤回了近期一些录用决定。奈飞裁员几百人。Coinbase和Robinhood等更年轻些的科技宠儿也一样。电动汽车制造商特斯拉的CEO马斯克宣布冻结招聘，并裁员十分之一左右。根据数据供应商Crunchbase，今年至今美国科技行业已有超过2.8万名员工失业。那些打定主意去科技行业的毕业生更可能选择老牌公司，而不是时髦光鲜但前景不明的创业公司。

| 以身试药

有些毕业生可能会转而选择另一些似乎不太容易受经济波动影响的高科技行业。走在新冠疫苗研发前沿的制药商特别受青睐。去年在英国最具吸引

力雇主排行榜上，各自推出了有效疫苗的阿斯利康（AstraZeneca）和辉瑞的排名都大幅上升。2021年，阿斯利康招收的高中和大学毕业生人数翻了一番。与此同时，俄乌战争可能会提升军火公司的吸引力。虽然它们会被一些千禧一代和X世代视为彻头彻尾不道德的公司而避之不及，但现在却能把自已描绘成“民主军火”的制造者。

毕业生越发重视工作稳定性也提升了公共部门的吸引力，英国招聘公司“毕业生招聘局”（Graduate Recruitment Bureau）的联合创始人丹·霍斯（Dan Hawes）指出。新冠疫情初期，英国申请政府职位的人数增加了近三分之一。据估计，今年3月英国公共部门的员工总数比一年前多6.7万人。去年11月，为角逐3.1万余个政府职位，大约140万中国人参加了以竞争激烈著称的国家公务员考试，比上一年增加了超过40%。

如果毕业生继续被安稳的政府工作所吸引，那么留给私人雇主的人才就会减少。尽管经济有放缓的迹象，但劳动力市场仍然吃紧。疫情期间许多年长的专业人员辞职了。还有人提早退休。

自疫情初次暴发以来，英国的劳动人口减少了25万多人。美国的就业人数减少了330万。最新的官方数据显示，美国有1130万个职位空缺，而失业人数只有600万。据成员主要为富裕国家的经合组织（OECD）称，美国劳动力市场的就业率至少需要四年才能恢复到疫情前水平。

为了吸引来年轻员工并让他们开心，企业愿意付出多少？就目前而言，简单的回答似乎是：很多。为提升自己在弹性工作方面的吸引力，花旗银行在西班牙海滨城市马拉加（Málaga）新开设了一个中心，尽管只有30个分析师职位，却吸引了3000多名申请者。而谷歌除了提供美食大餐、24小时开放按摩服务和休息舱，最近还请来了流行歌手莉佐（Lizzo）为员工表演。

想要吸引年轻人才，公司最好的做法就是舍得花钱。优兴咨询称，美国毕业生在找工作时看重的因素中，Z世代早期热衷的一些方面已经跌到了后头，包括雇主对多元化和包容性的承诺，或企业社会责任等。而有竞争力

的基本工资和未来可期的高收入的重要性上升了。摩根大通、高盛和花旗等银行以及麦肯锡和波士顿咨询公司等管理咨询公司已经将分析师第一年的年薪提高至10万美元。律师事务所也一直在提高起薪。英国能源巨头BP为应届毕业生提供高达5000英镑（6000美元）的签约奖金加之购车优惠。金钱虽非万能，但也还是有些能耐的。





Tearing down the bamboo walls

The trade war within China

Local protectionism is pernicious and persistent

Although many are embarrassed to admit it, foreign correspondents learn a lot from taxi drivers. In China economic correspondents can also learn a lot from the taxis themselves. Most cabs in Beijing are Hyundai Elantras. In Shanghai they are often the Volkswagen Touran or Passat. And in Wuhan they are commonly Citroën Elysées. In each case, the explanation is the same. These foreign brands have joint ventures with local state-owned carmakers that the city government is keen to champion—even if it is at the expense of other carmakers and their own consumers.

This is one prominent example of China's persistent "local protectionism". Many of its provinces, prefectures and counties try to shield local firms from outside competition. These measures divide the mainland's vast, singular market into something more plural. "China in many ways resembles the European Union," says Jörg Wuttke, president of the EU Chamber of Commerce in China. "We have 27 member states; they have 31." The EU has been trying to perfect its single market for three decades, often in the teeth of national rivalries and resentments. China has been battling local protectionism for just as long. Newspapers in 1991 were full of tales of "economic warlords" dividing China into "dukedom" protected behind "bamboo walls", recalls Andrew Wedeman in his book "From Mao to Market".

Some of those walls remain. If a provincial border divides two cities 200km apart, lorries will flow between them as if they were about 100km further apart, according to Lu Ming of Shanghai Jiao Tong University and his colleagues. The "toolbox" of local protectionism is "wide", says Mr Wuttke. Governments might, for example, put out a tender with customised

requirements that only a home-grown champion can fulfil. They might enforce rules on safety or unfair competition more zealously against outside firms. In the past governments have even given locally made cars priority access to express lanes, according to a paper by Panle Jia Barwick of Cornell University and her co-authors.

Some recent barriers were documented by China's National Development and Reform Commission (NDRC) in May. The province of Jilin, for example, required fertiliser companies to traipse to a local institute to get their products tested. The city of Ma'anshan refused to allow private firms to bid for the rights to mine dolomite without seven stamps from local departments (which withheld them because they "did not understand the companies' background"). Taiyuan required lorries to specify their route when applying for permits, which put drivers unfamiliar with the city at a disadvantage. The traffic-control departments in parts of Jiangxi province delegated the licensing of electric bikes to local insurance companies that compelled owners to buy insurance too. These cases of local malpractice have all been rectified, according to the NDRC. But it presumably hopes that publicising them will help deter similar meddling elsewhere.

One way to expose the seams in China's market is to see what happens when they are removed. China's counties (which have populations of about 500,000 on average) are sometimes absorbed into larger prefectures (with millions of residents), removing the administrative borders between them. When this happens, the absorbed counties tend to prosper. Their GDP per person was 12.6% higher than counties that applied to join a prefecture but failed, according to Yi Han of the University of Pittsburgh. The counties benefited from joining a larger market, just as small European countries benefit from joining Europe's single market.

Efforts to tear down these bamboo walls have gained new urgency in recent years. After the global financial crisis, the trade war and the pandemic,

China's rulers have concluded that they can no longer rely on foreign markets. They are trying to steer the economy away from a growth model based on importing vast quantities of commodities and components and exporting similarly vast quantities of manufactured goods (a model known as *da jin da chu*, "big in, big out"). Their attention has turned from fickle markets overseas to the one that has been in front of them all along.

In April the Communist Party's central committee and the Chinese government's state council (the equivalent of its cabinet) jointly published a set of opinions calling for a "national unified market". They lamented "market segmentation", "repetitive low-level construction" and "vicious competition in investment promotion". The timing was unfortunate, an exhortation to remove metaphorical bamboo walls just as literal metal fences were appearing in locked-down Shanghai. But the initiative is nonetheless welcome, says Mr Wuttke. "They realise this export miracle they experience now will end," he says. "They're trying to find other means to get the economy going. And knocking down protectionist walls is not a bad idea."

One worry is that if local governments lose regulatory discretion, they will stop building their economic dukedoms and instead "lie flat", lapsing into apathy. The fierce economic competition between different parts of China does, after all, keep local governments on their toes. But even in a more unified market, local governments could compete to provide good infrastructure, well-trained workforces and brisk administration of rules that are more standardised across the country.

The bigger worry is that local protectionism will persist despite the exhortations of China's rulers. A more unified market will create losers as well as winners. It will, for example, require some local carmakers to lose custom to rivals from elsewhere. Local officials resist these market forces for a reason. They wish to preserve jobs, tax revenues and social peace,

criteria that determine how they are evaluated by the party. If they imperil stability, they will also jeopardise their chances of promotion. To stop them bestowing favours on local champions, then, China's central government will have to rethink how it bestows favours on local cadres. ■



拆除竹墙

中国内部的贸易战

地方保护主义有害而顽固

虽然很多外国记者都不好意思承认，但他们从出租车司机身上学到了很多。在中国，经济记者还可以从出租车本身了解到很多。北京的出租车大多是现代伊兰特。在上海则往往是大众途安或帕萨特。在武汉常见的是雪铁龙爱丽舍。不管是在哪里，缘由都是一样的。这些外国品牌与当地国有汽车制造商建立了合资企业，市政府乐于支持——哪怕是以牺牲其他汽车制造商和自己的消费者为代价。

这是中国顽固的“地方保护主义”的一个突出例子。许多省、地级行政区和县都试图保护本地企业免受外部竞争。这些措施将中国大陆庞大而单一的市场划分为更多元的市场。“中国在很多方面都类似于欧盟，”中国欧盟商会会长伍德克（Jörg Wuttke）说，“我们有27个成员；他们有31个。”三十年来，欧盟一直顶着国家间的竞争和怨恨，努力完善其单一市场。中国与地方保护主义作斗争的时间一样久。安德鲁·韦德曼（Andrew Wedeman）在他的《从毛泽东到市场》（From Mao to Market）一书中回忆道，1991年的报纸充斥着“经济军阀”将中国割据为用“竹墙”保护的“诸侯国”的故事。

其中一些墙仍然存在。上海交通大学的陆铭和他的同事称，如果两个相距200公里的城市中间隔着省界，那对于在其间穿梭的卡车来说，就好像要再远上100公里。伍德克说，地方保护主义拥有“庞大”的“工具箱”。例如，政府可能会提出一个量身定制的招标要求，只有本地的领军企业才能满足要求。它们可能会更积极地针对外地公司执行有关安全或不公平竞争的规则。根据康奈尔大学的贾攀乐（Panle Jia Barwick）及合著者的一篇论文，在过去，政府甚至让本地制造的汽车优先进入快车道。

中国国家发改委在5月记录了近期存在的一些“路障”。例如，吉林省要求化肥公司与当地机构合作对其产品进行测试。马鞍山市说私营企业若要竞

标白云石的开采权，先得集齐当地部门的七个章（而这些部门拒绝盖章，因为“不了解公司的背景”）。太原要求货车在申请许可证时说明具体路线，这对不熟悉城市的司机不利。江西省部分地区的交管部门将电动自行车上牌权下放给当地保险公司，强制车主购买保险。国家发改委表示，这些地方上的错误做法均已得到整改。但它大概是希望公开这些案例有助于阻止其他地方做出类似的干预。

找到中国市场上“接缝”的一种方法，是看看当把它们去掉时会发生什么。中国的县（平均人口约为50万人）有时会被并入更大的地级行政区（拥有数百万居民），从而消除两者间的行政边界。这种情况下，被吸收的县往往会繁荣起来。根据匹兹堡大学的韩奕的数据，这些县的人均GDP比申请加入地级行政区但未能通过的县高12.6%。这些县受益于加入更大的市场，正如欧洲小国受益于加入欧洲的单一市场一样。

近年来，拆除这些竹墙的努力又有了新的紧迫性。在全球金融危机、贸易战和疫情之后，中国的治理者已经得出结论，自己不能再依赖外国市场。他们正试图引导经济摆脱基于大量进口商品和零部件、出口大量制成品的增长模式（这种模式被称为“大进大出”）。他们的注意力已经从变化无常的海外市场转移到一直就在他们眼皮底下的市场。

今年4月，中共中央和国务院（相当于内阁）联合发表了一系列意见，呼吁建立“全国统一市场”。他们感叹“市场分割”、“重复低层建设”、“招商引资恶性竞争”。时机很不巧，在劝导拆除比喻意义上的“竹墙”的同时，字面意义上的金属栅栏却出现在被封锁的上海。但是，伍德克表示，这一举措仍然受到欢迎。“他们意识到，自己现在经历的出口奇迹将会结束，”他说，“他们正试图寻找其他方式来推动经济发展。推倒保护主义的墙是个不错的主意。”

一种担忧是，如果地方政府失去监管的自由裁量权，它们将停止打造自己的经济诸侯国，“躺平”算数。毕竟，中国不同地区之间激烈的经济竞争确实让地方政府不敢松懈。但即使在一个更加统一的市场中，地方政府之间仍可以竞争，看谁能提供更好的基础设施、训练有素的劳动力，以及根据

在全国范围内更加标准化的规则开展高效的管理。

更大的担忧是，尽管中国的治理者有此劝告，地方保护主义仍将持续存在。一个更加统一的市场会带来赢家，也会带来输家。例如，这将使一些本地汽车制造商把生意输给外来竞争对手。地方官员抵制这些市场力量是有原因的。他们希望保住就业、税收和社会稳定，这些标准决定了他们如何被党组织评估。如果危及稳定，就会危及他们的晋升机会。那么，要阻止他们偏袒地方领军企业，中国中央政府就得重新考虑如何偏袒地方干部。 ■



The electric endgame for fossil fuels

Electrifying everything does not solve the climate crisis, but it is a great start

The transition still needs plenty of assistance

Walking into the grid control room at 50Hertz, a Berlin-based utility, on the morning of May 13th felt like walking onto the bridge of a spaceship: screens full of data, an air of competent calm and the underlying sense of an immense flow of power being guided on its journey. This hyper-secure site (and its mirror in another location) are charged with controlling the flow of electricity to 18m people in eastern and northern Germany.

Today the screens show 28% of that flow coming from wind farms and 24% from solar panels. A decade ago the custodians of the grids which keep the rich world's lights on would have told you this was impossible. Renewables were too troublesome, too hard to balance with demand moment by moment, too prone to fluctuations in the frequency of the current they provided. In 2011 a symposium of electricity mavens convened by MIT concluded that "Too much electricity generation from intermittent renewables is as much of a problem as too little generation."

This scepticism was understandable. Dirk Biermann, who is in charge of system operations at 50Hertz, points out that grid operators "are very conservative when it comes to system operations because, at any price, we have to make sure that the electricity supply is maintained." Nevertheless it was misplaced. The grid 50Hertz oversees is quite capable of running a transmission grid with 50-60% wind and solar power.

And the progress is not over. The company aims to be able to handle a 100% wind-and-solar grid by 2032. Mr Biermann sees that target as demanding—"We have to speed up"—and anticipates "moments of

tension” on the way. But he thinks it will be done. Some places, after all, are already doing it, if only for fairly short periods. Neighbouring Denmark has at times run its entire power grid on wind power alone. At 3.39pm on April 3rd over 97% of California’s power came from just wind and solar. A decade of technical, managerial and systems-engineering progress has put the design and management of grids dominated by renewables within the sober, risk-averse grasp of people who run electric grids. What was once touted as a fundamental barrier to the transition from fossil fuels has been done away with.

| *The rub of the green*

The ability to use renewables for the lion’s share of a grid’s supply, coupled with the fact that renewables have been made cheap and are getting yet cheaper, is the basis of a decarbonisation strategy all but universally accepted by those determined to stabilise the climate. Make the power on electric grids emissions-free, cheap and copious. Start electrifying all processes that now require fossil fuels—such as powering cars, or heating homes and steel foundries—where electrification is clearly possible. It does not deliver everything that is needed. But it delivers a lot.

Two decades ago the high price of emissions-free generating capacity made such a trajectory look both far-fetched and scary. Now it is seen by many as an opportunity. But it faces serious obstacles. This report looks at opportunities and obstacles alike. It also looks at the impact that the war in Ukraine is having on both.

One big issue is back-up. If there was twice as much renewable capacity on the 50Hertz patch—as there well could be in the 2030s, given present trends on cost and deployment—then on this breezy spring morning the grid would have access to all the power it needed. But after sunset during extended periods without wind, no amount of extra capacity is any help, however cheap it may be.

Mr Biermann says part of the answer to such *Dunkelflaute*—dark doldrums—is to expand the grid, bringing in renewable energy from a wider range of sources. Another part is to find ways to lower demand when supply is dicey. And increasingly capable batteries and other storage systems will be vital. But there will also be a need for back-up.

In Germany it will not be nuclear. The country's last nuclear plants are due to be shut down this year as part of a process begun in overreaction to the meltdown at Fukushima in 2011. And in no country should it be coal. With those options untenable, Germany has built up its renewables on the basis that, in the long run, backup will be provided by burning hydrogen produced using the grid's copious renewable resources. As the hydrogen-production capacity is built up, Mr Biermann says the plan had been to use natural gas as a stop-gap, slowly tapering it off as the hydrogen supply increased. This is not a perfect solution since, although gas produces fewer climate emissions than coal, it does still produce plenty of them. But it is a technically plausible one.

Politically, not so much. The Russian invasion of Ukraine did not just send natural-gas prices soaring. It also opened up concerns about security of supply, and the strategic viability of a supply dominated by a powerful enemy. In 2021 the EU imported 45% of its natural gas from Russia; for Germany, Europe's biggest gas consumer, the figure was 55% (see map).

| *Complex trade-offs*

The basic logic of post-Ukraine energy security, which applies far beyond Germany, is to rely as little as possible on flows of hydrocarbons from geopolitically dodgy sources. At one level it is a goal well served by adding renewable capacity to the grid as fast as possible. A kilowatt-hour from a solar panel or a wind turbine is one that does not need to be bought in the form of gas.

Increasing renewable generating capacity yet faster is already a priority for people who are devoted to climate security. In other ways, though, the two agendas diverge. However quickly they are crowded onto the grid, renewables cannot entirely eliminate Europe's need for gas; as well as providing back-up when renewables are not producing electricity, gas is vital to Europe's industrial heartland, not to mention heating many of its homes. So energy-security hawks want to increase greatly Europe's capacity to import liquefied natural gas (LNG).

Climate hawks look on this with trepidation. They argue that a low- to no-emissions future is not just a matter of reducing fossil-fuel use in existing infrastructure; it is about establishing system-level change through a once-and-for-all replacement of infrastructure. Investment in alternative sources of hydrocarbons on the scale needed to replace Russian supplies within a decade, they fear, will see hydrocarbons embedded in Europe's electricity system for decades to come. "Get new gas, then go green" is pitted against "To go green means no new gas".

The issue is not unique to Europe. Similar concerns were raised when Gavin Newsom, California's governor, announced that there would be a role for natural gas in a new \$5.2bn "strategic reserve" of capacity designed to ensure that the state's ambitious expansion of renewable power would not lead to blackouts.

These trade-offs between energy security and climate security are complicated further by one of the fundamental issues plaguing the race to decarbonise the economy. Is the technology needed already available? Or does it still need to be developed?

At one extreme are those who argue that all the tools necessary for radical decarbonisation already exist, and that the energy transition is a matter of finding political support for their deployment at an ever greater pace and

scale coupled with a willingness in the rich world (and sometimes, implicitly, in the developing world too) to make do with less energy. At the other are those who say that the transition will require whole rafts of technology not yet out of the lab, and in some cases not even in the lab.

The technical and the political are intertwined. If you believe that climate catastrophe looms in the near future you more or less have to believe in a technologically come-as-you-are transition. If you are deeply averse to climate action which requires massive political and economic disruption you will tend to favour going long on research.

This report will look at which technologies needed for a fast transition to a green grid are already available and deployable, and which need more work. It will look at what is required in order to do without natural gas and at how gas can be made more genuinely climate friendly, thus aligning energy security and climate security. Before doing all that, however, it will look at a technology that makes everything easier: one that lets grids manage demand, as well as supply. ■



化石燃料的电气化终局

使一切电气化并不能解决气候危机，但这是一个良好的开端

过渡仍需要大量支持【专题《气候技术》系列之一】

在5月13日早上，走进柏林公用事业公司50Hertz的电网控制室，感觉就像走进了一艘宇宙飞船的舰桥：满屏的数据、透着干练的平静气氛，以及隐约感到有庞大的电流被引领着踏上旅程。这个戒备森严的地方（以及另一个地方的一间一模一样的控制室）负责控制着供应德国东部和北部1800万人的电力流动。

今天，屏幕显示28%的流量来自风电场，24%来自太阳能电池板。十年前，维持富裕世界灯火通明的电网管理员会告诉你这是不可能的。可再生能源太麻烦，太难适配时刻变化的需求，提供的电流频率太容易出现波动。2011年，由麻省理工学院召集的电力专家座谈会得出结论：“间歇性可再生能源发电量过多和过少都一样是问题。”

这种怀疑是可以理解的。负责50Hertz系统运营的德克·比尔曼（Dirk Biermann）指出，电网运营商“在系统运营方面非常保守，因为无论付出什么代价，我们都必须确保维持电力供应。”尽管如此，它们还是多虑了。50Hertz监管的电网非常有能力运行一个风能和太阳能占50%到60%的输电网。

而且进展还没有结束。该公司的目标是到2032年能够处理100%风能和太阳能的电网。比尔曼认为这个目标要求很高——“我们必须加快速度”——并预计会出现“紧张时刻”。但他认为这还是可以做到的。毕竟有些地方已经在这样做了，即使只持续了相当短的时间。邻国丹麦有时仅依靠风能运行它的整个电网。4月3日下午3点39分，加州97%以上的电力仅来自风能和太阳能。经过十年的技术、管理和系统工程进步，审慎而厌恶风险的电网运营者差不多已经能够设计和管理以可再生能源为主的电网了。曾经一些人大声嚷嚷从化石燃料转型存在根本性障碍，但这种障碍现在已经消除了。

| 绿色的运势

能用可再生能源解决电网的大部分供电，加上可再生能源已经变得便宜并且还会越来越便宜，这支撑了一种让那些决心稳定气候的人几乎普遍接受的脱碳战略。要让电网的电力无排放、廉价而丰富。在显然可以实现电气化的地方——例如驱动汽车、家庭供暖和钢铁铸造厂——应开始把所有目前需要化石燃料的过程电气化。它不能提供所需的一切，但它提供了很多。

二十年前，无排放发电的高昂价格让这样的发展轨迹看起来飘渺又可怕。现在，许多人认为这是一个机会。但它面临着严重的障碍。本报告同时着眼于机遇和障碍，也会讨论乌克兰战争对两者的影响。

一个大问题是后备。如果50Hertz的可再生能源容量再翻一番——按照目前的成本和部署趋势，这到2030年代很有可能实现——那么在这个微风轻拂的春天早晨，电网将能够获得所需的所有电力。但是日落之后，如果长时间没有风，再多的装机容量也毫无用处，无论多么便宜。

比尔曼说，解决这种Dunkelflaute（黑暗无风期）的部分答案是扩大电网，从更广泛的来源引入可再生能源。另一部分是在供应不稳定时找到降低需求的方法。而越来越强大的电池和其他存储系统将至关重要。但依然需要后备。

在德国，后备能源不会是核。该国最后一座核电站将于今年关闭，这是因对2011年福岛核事故的过度反应而开始的进程的一部分。在任何国家都不应是煤炭。排除了这些选择后，德国建立可再生能源的理论基础是，从长远来看，它将使用电网中丰富的可再生资源生产氢气，并燃烧它来提供后备。随着制氢能力的建立，比尔曼表示，该计划一直是使用天然气作为权宜之计，并随着氢气供应的增加逐渐缩减。这不是一个完美的解决方案，因为尽管天然气产生的气候排放量比煤炭少，但依然很高。但这是技术上可行的一个方案。

政治上就不这么乐观了。俄罗斯入侵乌克兰不仅导致天然气价格飙升，还

引发了对供应安全以及被强大敌人主宰供应的战略可行性的担忧。2021年，欧盟45%的天然气从俄罗斯进口；对于欧洲最大的天然气消费国德国来说，这个数字是55%（见地图）。

| 复杂的权衡

乌克兰战争后的能源安全的基本逻辑（其适用范围远远超出德国）是尽可能不依赖来自地缘政治上不可靠的来源的碳氢化合物物流。在一个层面上，尽可能快地向电网增加可再生能源容量是一个很好的目标。来自太阳能电池板或风力涡轮机的一度电，是不需要以天然气的形式购买的一度电。

加快提高可再生能源发电容量已经成为致力于气候安全的人们的首要任务。然而，在其他方面，这两个计划存在分歧。不管它们挤进电网的速度有多快，可再生能源都不能完全消除欧洲对天然气的需求。除了在可再生能源不发电时提供备用电力外，天然气对于欧洲的工业中心地带至关重要，更不用说为许多家庭供暖了。因此，能源安全鹰派希望大幅提高欧洲进口液化天然气（LNG）的能力。

气候鹰派对此感到恐惧。他们认为，低排放到零排放的未来不仅仅是减少现有基础设施中化石燃料的使用；它要通过一劳永逸的基础设施更换来建立系统级的变化。他们担心，如果以能够取代俄罗斯供应的规模，在十年内对碳氢化合物的替代来源进行投资，将导致碳氢化合物在未来几十年内深深地嵌入欧洲的电力系统。“获得新天然气来源，然后变绿色”要与“变绿色意味着没有新天然气”一较高下。

这个问题并非欧洲独有。加州州长加文·纽森（Gavin Newsom）宣布，在确保该州宏伟的可再生能源扩张不会导致停电的52亿美元“战略储备”新产能中，天然气也有一席之地。这也引发了类似的担忧。

在让经济脱碳的竞赛中，一个基本问题让能源安全和气候安全之间的这些权衡变得更加复杂。所需的技术是否已经准备好了？还是仍需要开发？

一个极端的观点是，彻底脱碳所需的所有工具都已经存在，而能源转型的关键在于寻求政治支持来以更大的速度和规模部署这些工具，同时富裕国

家（有时也隐含地包含发展中国家）要有意愿减少能源消耗。另一个极端则认为，这种转变需要的大量技术尚未走出实验室，在某些情况下甚至还没有进入实验室。

技术和政治是相互交织的。如果你认为在不久的将来会发生气候灾难，那么你多少就得相信那些技术上“匆匆上马”的转变。如果你非常反对会带来大规模政治和经济动荡的气候行动，你将倾向于进行长期研究。

本报告会讨论，哪些快速过渡到绿色电网所需的技术已经可用和可部署，而哪些还需要更多研发工作。它会研究需要做什么才能完全不用天然气，以及如何使天然气变得真正更加气候友好，从而使能源安全和气候安全保持一致。然而，在做这一切之前，它将关注一种使一切变得更容易的技术：一种让电网不仅管理供应，更管理需求的技术。■



The people's power

Getting the most out of tomorrow's grid requires digitisation and demand response

It might also need a dash of democracy

Frequencies matter. When a singer misses a note, a choir's harmony can be ruined. When an electric grid wobbles around off key, equipment attached to it can be badly damaged. Worries about the fluctuations that renewables might bring with them in the frequency at which an electrical grid operates (50 hertz, or cycles a second, in most of the world, 60 hertz in much of the Americas and a few parts of Asia) have caused grid operators to be leery of renewable energy.

Now some renewables have developed perfect pitch. On May 11th Huawei, a Chinese technology goliath, unveiled the latest version of FusionSolar, a smart-home system that combines solar cells and energy storage. One of its features is "grid-forming" software which allows the system to set itself precisely to the grid's frequency, helping to stabilise it.

Distributed energy resources (DERs) like smart houses with solar panels demand more from grids—but systems like FusionSolar allow them to offer more, too. Taking up that offer is not easy. A grid connecting millions of systems that draw power at some times and supply it at others becomes "increasingly complex to plan for, orchestrate and keep in balance," says Audrey Zibelman. After three decades as a utility executive, network operator and regulator in America and Australia Ms Zibelman now works at X, the irritatingly named outfit which serves as a "moonshot" incubator for Google's parent company, Alphabet. Her project there, Tapestry, aims to provide what she calls "Google Street View for the grid". With copious sensors, data from DERs and smart software she aims to make the grid manageable at a level of subtlety never seen before.

Combining DERs with this ability to see what is going on in exquisite detail is a challenging task. There is a risk that so much data will prove paralyzing. But those who can pull it off will see real benefits in terms of flexibility. Many of the new things being connected to the grid in large numbers, such as heat pumps and electric vehicles, have significant room for manoeuvre as to when, and how much, they consume. If what they have to offer can be accurately appraised and matched to what is happening on the supply side that flexibility becomes a powerful economic asset.

Demand management is a breakthrough long discussed and just as long deferred. Utilities which were heavily regulated, monopolies or both saw little reason to “modify, adjust, manage, shape, shift or shed customers’ demand,” Fereidoon Sioshansi writes in a recent book, “Variable Generation, Flexible Demand”. They just added capacity and passed on the costs. Providing customers with price signals did not live up to the promise market-minded reformers imagined for it. Ordinary people do not want to spend all their time on energy day-trading sites to save a few pennies on power. As Amory Lovins, an alternative-energy guru who co-founded a think-tank called the Rocky Mountain Institute (RMI), has long argued, what people want from energy is simply “cold beer and hot showers”.

Acknowledging this is the key to the strategy Mr Sioshansi champions: “we need to automate things, essentially bypassing the customers.” New DER-enabled smart grids are an excellent way of doing this. Customers can set preferences as to what they need charged up and when, as they do in a new scheme offered by Octopus Energy Group, a British provider. After that they let the system do as it wants—an approach the company says can, among other things, lower the cost of charging an electric vehicle (EV) by 75%. Such savings by consumers equate, at some point, with savings for the suppliers in terms of electricity they did not have to ship down congested transmission lines.

An in-depth study carried out by America's Pacific Northwest National Laboratory puts numbers to some of the possibilities. It analysed the impact of using dynamic price signals to automatically incentivise and coordinate a variety of DERs on a theoretical grid the size of Texas. Operation stabilised, loads were lowered, household-power prices dropped by 10% to 17%. The need for transmission, distribution and generating infrastructure fell.

In Britain a new regime for distribution-system operators means that utilities will be able to solicit DERs via open and transparent "flexibility" markets. That should allow them to provide better services without having to add generating or transmission capacity. In Australia, Energy Web, a charity co-founded by the RMI, is working with the energy-market operator, a big distribution utility and several aggregators of distributed resources to develop a "transactive" energy market that allows customer-owned DERs to bid into the wholesale energy market.

The check on such things is not because of a lack of interest in greening; it is because of opposition from incumbents. This can be as marked in purportedly green countries as anywhere else. The Association of Energy Market Innovators, a European trade group, grouses that "Germany's regulatory framework for its smart meter roll-out...should by no means serve as a role model." Jesse Morris of Energy Web complains that, in California and Hawaii, utilities are allowed to "simply prevent—either directly or via prohibitively high interconnection fees—DERs from being added to the grid."

The commercial and industrial market for flexible demand is taking off too. Enel X, part of Enel, an Italian electricity giant, is one of the biggest aggregators of demand response, something its customers are coming to appreciate. Kimberly Clark, a big consumer-products firm, gave it authority over 5mw of load at one of its factories, allowing it to sell the grid

“negawatts” at times of peak demand. With no capital investment and no big change in operations the company earned over \$2m from the scheme.

This Technology Quarterly was written in a comfortably cooled and well-lit apartment in a high-rise owned by one of New York City’s largest landlords. Unbeknown to your correspondent until recently, some of that landlord’s buildings now have solar capacity as well as energy-storage systems managed by Enel X that provide the grid-system operator with demand response at peak load. Good for avoiding blackouts, good for the landlord’s profits and all done without haranguing tenants to make fiddly green choices, just as it should be. ■



人民的电力

要充分利用未来的电网需要数字化和需求响应

它可能还需要一点儿民主【专题《气候技术》系列之二】

频率很重要。合唱团里有一个人一个音没唱准，和声可能就被毁了。当电网动荡不稳时，连接到电网的设备可能会严重受损。电网运营商担心可再生能源会给电网的运行频率（世界大部分地区为50赫兹——即每秒电流有50个周期，美洲大部分地区和亚洲部分地区为60赫兹）带来波动，一直对这种能源很警惕。

现在，一些可再生能源已经发展出了“绝对音感”。5月11日，中国科技巨头华为发布了最新版本的FusionSolar。这是一个结合了太阳能电池和储能智能家居系统。其特性之一是“grid-forming智能光储协同控制算法”，让这套系统能精准调控自身以适应电网频率，支撑电网稳定性。

像带有太阳能板的智能房屋这样的分布式能源（DER）对电网提出了更高要求，但像FusionSolar这样的系统使得它们也可以为电网提供更多电。吸收这些电并不容易。如果一个电网连接了成百上千万个系统，它们时而从电网取电，时而又往回供电，这种电网的“规划、协调安排及保持平衡”变得日益复杂，奥德丽·齐贝尔曼（Audrey Zibelman）说。齐贝尔曼曾在美国和澳大利亚任职电力公司高管、电网运营商和监管官员30年，目前在X工作——这个名字令人莫名恼火的部门是谷歌母公司Alphabet的“登月”孵化器。她在那里研发Tapestry项目，她称其目标为提供“用于电网的谷歌街景”。凭借大量传感器以及来自DER和智能软件的数据，她要以前所未有的精细度管理电网。

把DER与这种精细观察实时状况的能力结合起来是一项颇具挑战性的任务。如此海量的数据有导致系统瘫痪的风险。但那些能把这件事做成的人将会看到灵活性带来的真正益处。许多以众多数量连接到电网的新事物——比如热泵和电动汽车——在何时用电以及用多少电方面有很大的回旋余地。如果它们反向输送电力的能力能被准确评估，并与电网的实时供电

状况相匹配，那么灵活性就会成为一种强大的经济资产。

需求管理是一项突破，它被长期讨论，也被长期推迟。不论是受到严格监管的电力公司还是垄断者都看不到什么理由要去“修改、调整、管理、塑造、转移或摆脱客户的需求”，费雷敦·西奥山斯（Fereidoon Sioshansi）在最近出版的《可变发电，灵活需求》（Variable Generation, Flexible Demand）一书中写道。它们就是简单地扩大产能，再转嫁成本。向客户提供价格信号并没有兑现具市场意识的改革者的构想。普通人不会想要整日查看能源日交易网站，只为省下几分钱电费。正如替代能源专家、智库落基山研究所（RMI）的联合创始人艾默里·洛文斯（Amory Lovins）老早就指出的，人们想从能源中得到的不过就是“冰镇啤酒和热水浴”。

承认了这一点，就能理解西奥山斯倡导的战略：“我们需要让事情自动化，基本上绕过客户。”由DER支撑的新智能电网是一个很好的实现办法。就像在英国供电公司Octopus能源集团推出的一个新方案里，客户可以设置偏好，说明何时需要给什么充电。之后他们就任由系统自己去调度了。该公司表示，这种方法的好处之一是可将电动汽车的充电成本降低75%。有时，消费者省下了多少，供应商也就省下了多少，因为它们不必在输电线拥挤时输电了。

美国的太平洋西北国家实验室（Pacific Northwest National Laboratory）开展的一项深入研究演算了一些可能的前景。假设有一个规模能覆盖整个德克萨斯州的电网，研究人员分析了使用动态价格信号来自动激励和协调各种DER对该电网的影响。结果运行稳定了，负荷下降了，家庭用电价格下跌了10%到17%。对输电、配电和发电基础设施的需要减少了。

英国出台了一个新的配电系统运营商制度，将让电力公司能够通过开放、透明的“灵活性”市场招揽DER并网。这应该会让它们不需要增加发电或输电容量就提升服务。在澳大利亚，由RMI共同创立的慈善机构Energy Web正与能源市场运营商、一家大型配电公司和几个分布式资源聚合商合作开发一个“交易”能源市场，让客户拥有的DER能够竞争接入批发能源市场。

对这类事物的制约并非缘于对绿色能源缺乏兴趣，而是因为老企业的反对。这一点在所谓的绿色国家可能和在其他任何地方一样显而易见。欧洲行业组织能源市场创新者协会（Association of Energy Market Innovators）不满地表示，“德国对其智能电表推广的监管框架.....绝不该成为榜样。”Energy Web的杰西·莫里斯（Jesse Morris）抱怨，在加州和夏威夷，电力公司被放任“就是阻拦DER入网——要么直接不让进，要么设置天价接网费用吓退你”。

灵活需求模式的工商业市场也在起飞。意大利电力巨头Enel旗下Enel X是最大的需求响应聚合商之一，其客户已开始见证需求响应的好处。大型消费品公司金百利（Kimberly Clark）授权Enel X管理其一家工厂超过5兆瓦的负载，让它能在用电需求高峰期向电网出售“负瓦”。无需资本投资，也没有对运营做任何重大调整，这家公司从该计划中赚了200多万美元。

本期技术季刊是在纽约市最大的房东之一拥有的一栋高层公寓里写就的，屋内冷气舒适，灯光明亮。笔者是在最近才了解到，这个房东的一些物业现在拥有太阳能板发电以及由Enel X管理的储能系统，能给电网运营商提供高峰时段需求响应。这能避免停电、增加房东收益，也不曾有谁说教租户做出繁琐的绿色选择——就应该是这样啊。 ■



The Economist Film

How does raising interest rates control inflation? Trailer

When central banks raise interest rates, the impact is felt far and wide. So why do central banks do it?



经济学人视频

预告 | 提高利率为何能控制通胀？

央行提高利率的经济影响深远，它们为何这么做？



Bartleby

Reading corporate culture from the outside

It is becoming a bit easier to peer inside firms

Culture eats strategy for breakfast, runs the aphorism. It also projectile vomits employees who don't fit in. In a survey conducted earlier this year by Flexjobs, an employment site, culture was the most common reason people gave for quitting. And it matters more than high wages. A study published last year by Jason Sockin of the University of Pennsylvania found that workers rated things like respectfulness, work-life balance and morale as more important to job satisfaction than pay.

The problem is that culture can be very hard to fathom from the outside. It resides in quotidian interactions between colleagues and in the hidden threads that bind decisions on everything from promotions to product development. You need to be inside an organisation to really understand it. But more sunlight is getting in. Firms are doing more to signal what they stand for. Jobseekers have new ways to peer inside firms. So do investors, who share their interest in evaluating corporate culture.

Offices are places where culture can be transmitted osmotically. Now that more workers are remote, firms increasingly write down their values. Qualtrics, a software firm, may not believe in grammar but it does believe in Transparent, All in, Customer obsessed, One team and Scrappy. Justworks, an HR technology firm, subscribes to Camaraderie, Openness, Grit, Integrity and Simplicity. Lists like these can turn blandness into an art form, and are overly determined by what will create an acronym. They may not reflect what actually happens inside the company. Plenty of firms are characterised by Cluelessness, Rancour, Amateurism, Skiving and Stupidity, but you won't find that on the website.

But companies that codify their values are at least thinking about them. And their choices can offer meaningful clues. Kraken, a cryptocurrency exchange, sets out its beliefs in ten “Tentaclemandments”. You need to see only that one word to know whether this is the workplace for you or whether you would rather be hurled into an active volcano.

Updates can also be instructive. In “ReCulturing”, a new book, Melissa Daimler lays out some of the changes that Dara Khosrowshahi made when he became CEO of Uber in 2017. The values of the previous regime, which included “Superpumped” and “Always be Hustlin’”, were overhauled for something a little less hormonal. The change from “Meritocracy and toe-stepping” to “We value ideas over hierarchy” told people something useful about the aspirations of the new leadership team.

Culture is increasingly readable in other ways, too. Since the pandemic, firms’ policies on remote working have given outsiders greater clarity on how employers view issues like work-life balance. Under increasing pressure from employees to take stances, companies are likelier to offer opinions on political and social issues. Others go the other way: Coinbase, another crypto firm, has made it clear that it won’t tolerate employee activism on subjects unrelated to its core mission. That’s information, too.

Windows on cultural norms are being opened by regulators, who are pushing for greater disclosure about firms’ workforces. Candidates seem to value this kind of information: a working paper published earlier this year by Jung Ho Choi of Stanford Graduate School of Business and his co-authors found that clickthrough rates for job postings rose for firms with higher diversity scores.

The behaviour of CEOs used to be directly visible only to a limited number of people. Now bosses are everywhere, tweeting, posting and making stilted videos. In a recent survey by Brunswick Group, a PR firm, 82% of

respondents said they would research the boss's social-media accounts if they were considering joining a new firm. Even earnings calls offer insights. Academics at Columbia Business School and Harvard Business School have found that managers who invite colleagues to respond to analysts' questions on these calls are more likely to work in firms that have more cohesive leadership teams.

Employee-review sites like Glassdoor are another source of insight. These sites can be distorted by embittered ex-workers. But, says Kevin Oakes of the Institute for Corporate Productivity, a research outfit, they are also likely to contain "slivers of truth". And all these slivers add up. There is no substitute for being at a firm day in, day out, if you want to understand what it is really like. But the outlines of corporate culture are more discernible than ever. That ought to lead to fewer cases of indigestion. ■



巴托比

从外部了解企业文化

窥探公司内部情况变得容易了一些

有句格言说，文化轻松吃掉战略。它还会把不合它胃口的员工狂吐出来。就业网站Flexjobs今年早些时候的一项调查显示，企业文化是员工最常给出的辞职原因。而且它比高工资更重要。宾夕法尼亚大学的杰森·索金（Jason Sockin）去年发表的一项研究发现，就工作满意度而言，员工认为受尊重、工作与生活的平衡，以及士气等因素比薪酬更重要。

问题是，文化很难从外部彻底了解。它根植于同事之间的日常互动中，也体现在串联起从晋升到产品开发等各种决策的隐形线条上。你只有身在其中才能真正了解它。但现在，更多的光亮正照射进企业的围墙。它们正在更积极地表明自己的立场。求职者有了新的途径来一探公司内部。投资者也是如此，他们对评估企业文化同样抱有兴趣。

在办公室里，文化可以潜移默化地传播。随着越来越多的员工远程工作，企业也更多将其价值观付诸文字。软件公司Qualtrics认同的价值观是“透明、全心全意、客户至上、团结一心和斗志昂扬”，尽管它在语法上不那么讲究。人力资源技术公司Justworks信奉“友爱、开放、坚毅、正直和简单”。这样的词汇罗列可以将索然无味的概念变成一种艺术表现形式，它们往往过分拘泥于用首字母拼出一个词。它们也许并不能反映公司内部的实际情况。许多公司的特点实则是无知、内斗、业余、偷懒和愚蠢（译者注：英语字首组合词是CRASS——“愚钝”），但它们的网站上可不会这么写。

但是，明文规定自己价值观的公司至少还是在思考这些理念的。而它们的选择有可能提供有意义的线索。加密货币交易所Kraken（意为海怪）以“Tentaclemandments”（触手十诫）来阐述自己的信念。只要看到这么一个词，你就知道自己是愿意来这里工作，还是宁愿跳进火坑。

从价值观的版本更新中也可以看出端倪。梅丽莎·戴姆勒（Melissa Daimler）在新书《文化重构》（ReCulturing）中列出了达拉·科斯罗萨西（Dara Khosrowshahi）在2017年担任优步CEO后所做的一些改变。他全面调整了前一任掌门的价值观——包括“打上鸡血”和“奔忙不休”，换成了一些不那么热血的词语。从“任人唯贤，敢于冒犯”转变为“重视创想，无论层级”，让人们对新领导团队的抱负有了一些有用的见解。

从其他方面了解企业文化也越发容易了。疫情暴发以来，公司的远程办公政策让外界更清楚地了解到雇主如何看待工作与生活的平衡等问题。随着员工日益要求明确立场，企业如今也更可能对政治和社会议题发表意见。也有公司反其道而行之：另一家加密货币公司Coinbase明确表示，不会容忍员工过多参与与其核心使命无关的议题。这本身也是一种信息。

监管机构正在推动公司更多披露员工队伍的情况，让外界得以一窥其文化规范。求职者似乎十分看重这类信息：斯坦福大学商学院的崔荣浩（Jung Ho Choi）及共同作者在今年早些时候发表的一篇工作论文中发现，员工多样性得分较高的公司发布的招聘广告点击率也更高。

过去，只有少数人能直接观察到CEO们的行为。现在，老板们无处不在，他们发推、发帖，还发布一本正经的视频。在公关公司博然思维

（Brunswick Group）最近的一项调查显示中，82%的受访者表示，他们在考虑加入一家新公司之前会研究其老板的社交媒体账号。就连财报电话会议也会透露玄机。哥伦比亚商学院和哈佛商学院的学者发现，如果管理者在电话会议上邀请同事回应分析师的提问，那么这家公司的领导团队往往更有凝聚力。

像Glassdoor这样的员工点评网站是另一个获得洞察的来源。这些网站上可能会有心怀愤懑的前员工歪曲事实。但是，研究机构企业生产力研究所（Institute for Corporate Productivity）的凯文·奥克斯（Kevin Oakes）说，它们也可能包含“零散的真相”。而所有碎片可以拼凑出一个整体印象。如果你想了解一家公司的真实情况，没有什么比得上日复一日地在那里工作。但企业文化的轮廓比以往任何时候都更清晰了。这应该能减少消

化不良的情况。■



Free exchange

Inflation shows both the value and limits of monetary-policy rules

A search for the right equation to overcome the fallibility of human judgment

It was a curious omission. In February, when the Federal Reserve published the winter edition of its semi-annual report to Congress, it dropped a normal section outlining the appropriate level of interest rates as determined by “monetary-policy rules”. Its inclusion might have been awkward, because it would have suggested that rates should be as high as 9%, when the Fed still had them near to 0%. In subsequent hearings at least three members of Congress pressed Jerome Powell, the Fed’s chairman, to explain its absence. Mr Powell promised that the section would be back in its next report. And so it was when the summer edition was published on June 17th—though only after the Fed had started to catch up to the rules’ prescriptions by rapidly raising rates.

As controversies go, the disappearance of a three-page section in a lengthy policy report was rather minor. It garnered scant media coverage. Nevertheless, it was important. It shone light on a decades-old question that is being asked with more insistence amid soaring inflation: should central banks limit their discretion and set interest rates according to black-and-white rules?

The search for rules to guide and constrain central banks has a long pedigree. It dates back to the 1930s when Henry Simons, an American economist, argued that authorities should aim to maintain “the constancy” of a predetermined price index—a novel idea in his era. In the 1960s Milton Friedman called for central banks to increase the money supply by a set amount every year. That monetarist rule was influential until the 1980s, when the relationship between money supply and GDP broke down.

Any discussion of rules today conjures up a seminal paper written in 1993 by John Taylor, an economist at Stanford University. In it he presented a straightforward equation which came to be known as the “Taylor rule”. The only variables were the pace of inflation and the deviation of GDP growth from its trend path. Plugging these in produced a recommended policy-rate path which, over the late 1980s and early 1990s, was almost identical to the actual federal-funds rate, the overnight lending rate targeted by the Fed. So it seemed to have great explanatory power. Mr Taylor argued that his rule might help to steer central banks on the right path for rates in the future.

However, just as the Taylor rule started to get attention from economists and investors alike, its explanatory power grew weaker. In the late 1990s the recommended Taylor rate was consistently lower than the fed-funds rate. That sparked a cottage industry of academic research into alternative rules, mostly grounded by Mr Taylor’s original insights. Some put more weight on the GDP gap. Others added inertia, since central banks take time to adjust rates. Another group shifted from current inflation to forecasts, trying to account for the lag between policy actions and economic outcomes. In its reports the Fed usually mentions five separate rules.

The appeal of rules lies in their cold neutrality: they are swayed only by numbers, not by fallible judgment about the economy. Central bankers love saying that their policy decisions are dependent on data. In practice they sometimes struggle to listen to the data when their message is unpalatable, as it has been with inflation for the past year. Central bankers found numerous reasons, from the supposedly transitory nature of inflation to the limited recovery in the labour market, to delay raising rates. But throughout that time, the suite of rules cited by the Fed was unambiguous in its verdict: tightening was needed.

The rules are, however, not perfectly neutral. Someone first has to construct them, deciding which elements to include and what weights to ascribe to

them. Nor are they as tidy as implied by the convention of calling them “simple monetary-policy rules”. They are simple in the sense that they contain relatively few inputs. But just as a bunch of simple threads can make for one messy knot, so a proliferation of simple rules has made for a baffling array of possibilities. For example, the Cleveland Fed publishes a quarterly report based on a set of seven rules. Its most recent report indicated that interest rates should be anywhere between 0.6% (per a rule focused on inflation forecasts) and 8.7% (per the original Taylor rule)—an uncomfortably wide range.

Moreover, each rule is built on top of a foundation of assumptions. These typically include estimates of the long-term unemployment rate and of the natural interest rate (the theoretical rate that supports maximum output for an economy without stoking inflation). Modellers must also settle on which of a range of inflation gauges to use. Slight changes in any of these inputs—common during periods of economic flux—can produce big swings in the rates prescribed by the rules. For example, an adjusted version of the Taylor rule, based on core inflation, would have recommended an interest-rate increase of a whopping 22 percentage points over the past two years (starting from negative 15%). Slavishly following such guidance would make for extreme volatility.

| *Average elegance*

One possible solution is to combine multiple rules into a single result. The Cleveland Fed does just this, constructing a basic median out of the seven rules it tracks. Using this as a reference point, Mr Powell and his colleagues ought to have started raising rates gingerly in the first quarter of 2021 and should have brought them to roughly 4% today, more than twice as high as they actually are. That is much more sensible as a recommendation than the conclusion yielded by any single policy rule.

Such a median could never substitute for analysis of a range of data by

central banks. But there is a big difference between taking rules seriously and treating them as holy writ. After all the inflation missteps of the past year, a healthy sample of rules deserves a closer look in policy debates. And they certainly deserve more prominence than they currently get as a short section in monetary reports that the Fed can choose to omit when inconvenient. ■



自由交流

通胀揭示了货币政策规则的价值和局限性

寻找正确的公式来避免人为判断失误【央行策略转向系列之四】

这个遗漏有点意思。今年2月，当美联储向国会发布其半年度报告的冬季版时，它漏掉了一个常规部分——根据“货币政策规则”大致确定适当的利率水平。把这部分内容包含进去可能会很尴尬，因为它会认为利率应该高至9%，但美联储此时仍将利率维持在接近0%的水平。在随后的听证会上，至少有三名国会议员向美联储主席杰罗姆·鲍威尔（Jerome Powell）追问报告缺失这一部分的原因。鲍威尔承诺，下一次报告将重新加上这个部分。6月17日发布的夏季版也确实加进了这个部分，只不过那时美联储已开始迅速加息以让利率赶上货币政策规则建议的水平。

就争议性而言，在一份冗长的货币政策报告中不见了一个三页长的部分并没什么大不了。媒体对此也鲜有报道。尽管如此，它却是重要的。它揭示了一个存在了几十年的问题，而且这个问题在通胀飙升的情况下被问得更多了，那就是央行是否应该限制自己的自由裁量权，而根据白纸黑字写明的规则来设定利率？

寻找规则来指导和约束央行的努力由来已久。这可以追溯到上世纪30年代，当时美国经济学家亨利·西蒙斯（Henry Simons）认为，当局应该努力保持预设价格指数的“稳定性”，这在他那个时代是一个新奇的想法。到60年代，米尔顿·弗里德曼呼吁央行每年增加固定数量的货币供应。直到80年代货币供应与GDP增长之间的关联被打破，这种货币主义规则一直很有影响力。

今天任何关于规则的讨论都会让人想起斯坦福大学的经济学家约翰·泰勒（John Taylor）在1993年撰写的一篇开创性论文。他在文中提出了一个简单的等式，后来被称为“泰勒法则”。等式中只有两个变量：通胀速度与GDP增长与其趋势路径的偏离。代入这两个变量后得出的建议政策利率与80年代末至90年代初实际的联邦基金利率（即美联储作为目标的隔夜拆解

利率)几乎一致。所以它似乎有很强的解释能力。泰勒认为,他的法则可能有助于引导各国央行在未来的利率设定上走上正确的道路。

然而,就在泰勒法则开始受到经济学家和投资者的关注时,它的解释能力却越来越弱。在90年代后期,它建议的利率一直低于联邦基金利率。这引发了一小部分零散的对替代性规则的学术研究,基本上都以泰勒最初的规则为基础。有些人更加强调GDP的偏差。其他人增加了惯性这个变量,因为央行调整利率需要时间。另一组研究人员的关注点从当前的通胀转向了预测,试图反映政策行动和经济结果之间的滞后。美联储在其报告中通常会提到五种不同的规则。

规则的吸引力在于它们冰冷的中立性。影响规则的只有数字,而不是容易出错的对经济的判断。央行官员很喜欢说他们的决策取决于数据。实际上,当数据给出的信息令人难以接受时,他们有时也听不进去,过去一年里在通胀问题上就是这种情况。从相信通胀的暂时性特性,到劳动力市场的有限复苏,央行官员找了许多理由来推迟加息。但在那段时间里,美联储引用的那些规则都得出了毫不含糊的结论——需要收紧政策了。

然而,这些规则并不是完全中立的。首先,规则必须由人来构建,由人来决定要包含哪些因素以及赋予它们多少权重。人们一般把它们称作“简单的货币政策规则”,但这些规则不像这种叫法所暗示的那样简洁。简单是说它们包含的输入相对较少。但是,就像一把简单的细线可以打成一个乱结一样,许多简单规则的并存会产生一系列可能性而令人困惑。例如,克利夫兰联储根据七种规则发布季度报告,其最近的报告表明利率应该在0.6%(根据关注通胀预测的规则)和8.7%(根据最初的泰勒法则)之间,范围之大叫人头疼。

此外,每条规则都建立在假设的基础之上。这些假设通常包括对长期失业率和自然利率(在不引发通胀的情况下支持经济最大化产出的理论利率)的估计。建模者还必须在各种通胀指标中选定一个。这些输入的任何微小变化都会导致规则生成的利率大幅波动,而输入值的变化在经济波动时期很常见。例如,采用核心通胀的改进版泰勒法则认为在过去两年中利率应

大幅提高22个百分点（从负15%开始）。盲目地遵循这样的指导会导致极端的波动。

| 优雅折中

一种可能的解决方案是整合多个规则，输出一个结果。克利夫兰联储就是这样做的，它根据所追踪的七个规则构建了一个基本中间值。以此为参照点来看的话，鲍威尔和他的同事们本应在2021年第一季度开始谨慎加息，到现在应该将利率提高到大约4%，是目前实际水平的两倍多。这个建议比任何单一政策规则得出的结论都要合理得多。

这样的中间值永远无法替代央行对一系列数据的分析。但是，重视规则和将其奉若神明是有很大的区别的。在过去一年的种种通胀决策失误之后，理应在政策辩论中更仔细地参考一套合理的规则。它们毫无疑问应该在货币政策报告获得更多篇幅，而不是美联储在感觉不便之时可以拿掉的一小部分。 ■



Three currencies, two theories, one burger

Dollar-euro parity may be justified. But the yen looks cheap as chips

How to use economic theory to value currencies

Imagine you are a Parisian investor trying to decide whether to buy American or European bonds. You compare the yields on offer. A ten-year bond issued by America's Treasury today offers 3%; German bunds return only 1.2%. But buying American means taking a gamble on the euro-dollar exchange rate. You are interested in the return in euros. The bond issued in Washington will be attractive only if the extra yield exceeds any expected loss owing to swings in currency markets.

This thinking, known as "uncovered interest parity" (UIP), explains why the dollar has recently soared against the euro. On July 12th the greenback reached a one-for-one exchange rate with the euro for the first time since 2002. (It has since fallen slightly.) UIP posits that changes in interest rates drive currency movements. If yields on Treasuries rise relative to those on bunds, then the dollar should strengthen until investors expect it to fall over the lifetime of the bonds, so that there is no longer any extra return from buying Treasuries. The Federal Reserve is expected to raise interest rates above 3.5% in 2023, more than twice the rate expected to be reached by the European Central Bank. The dollar has also risen by 20% against the yen in 2022 so far. That is probably because the Bank of Japan is not expected to raise rates above 0.2% in the next three years.

Yet there is more to currency valuation than monetary policy. Another theory, purchasing-power parity (PPP), says currencies and prices should adjust until a basket of goods and services costs the same everywhere. The Economist has its own lighthearted measure of PPP: the Big Mac index, which was updated on July 20th. Instead of a basket of goods and services, it uses differences in the price of the ubiquitous McDonald's burger to

judge whether currencies are over- or undervalued.

Our measure suggests the weak euro may be justified (see chart). The headline index, which assumes Big Macs should cost the same everywhere, predicts an exchange rate of 1.11 dollars per euro. But a secondary index, which adjusts for differences in GDP, says the euro should trade just below dollar parity. The GDP-adjusted index takes into account differences in the prices of inputs, such as land and labour, that are hard or impossible to trade across borders, and therefore reflect local incomes. At dollar-euro parity, a Big Mac is 11% more expensive stateside. But because America is richer than Europe, such a difference in prices could make sense.

For the euro, then, the two theories of currency valuation look aligned. Not so for the yen, which is more than 40% undervalued against the dollar on both Big Mac indices. (Book that flight to Tokyo, American burger-lovers.) The yen has become more undervalued since January, both because the dollar has surged and because inflation is much higher in America. A Big Mac in Japan, including taxes, costs ¥390, a price that has not changed since 2018. The American price, \$5.15, has gone up by 11.5% in that time, and by 2.2% since January.

That UIP is explaining recent movements better than PPP is no surprise. When exchange rates get out of whack with interest rates, traders can make a profit at the touch of a button. To the extent that varying purchasing power presents opportunities, it is to people and firms who might change the site of production or ship goods across borders. That takes time. And it is not always possible: the international delivery of Big Macs would be ill-advised.

PPP can fail even within currency zones. Our new index incorporates a change to the source for American Big Mac prices. We used to collect an average price from restaurants in four cities: Atlanta, Chicago, New York

and San Francisco. These are relatively expensive places. Now we use a median price for the whole country, provided by McDonald's, which is lower. The result is that the dollar does not look quite as strong. The change has been made for the whole history of the index, though the previous version is available online. We have also refined our method for calculating the GDP-adjusted index. Fans of burgernomics should tuck in.

To view an interactive visualisation of The Economist's Big Mac index, go to economist.com/big-mac-index ■



三种货币、两套理论、一个汉堡

美元-欧元平价也许合理，但日元太过便宜了

如何运用经济理论评估货币价值

假设你是一个巴黎的投资者，正在犹豫是购入美国债券还是欧洲债券。你会去比较两者的收益率。目前，美国财政部发行的十年期国债收益率是3%，德国国债的收益率仅为1.2%。但购入美债意味着要在欧元兑美元汇率上赌一把，毕竟你想要的是欧元回报。只有当收益率差值超出货币市场波动带来的任何预期损失时，美债才有吸引力。

这一名为“非抛补利率平价”（uncovered interest parity，以下简称UIP）的理论解释了最近美元兑欧元汇率为何飙升。7月12日，美元兑欧元汇率自2002年以来首次达到1比1，之后略微下滑。UIP理论认为利率变化带动货币汇率波动。假如美债收益率相对德债收益率上升，那么美元应该走强，直到投资者认为它会在债券持有期内下降，这样购买美债就不再有超额回报。市场预计美联储将在2023年加息至3.5%以上，是欧洲央行预计利率的两倍多。2022年至今，美元兑日元汇率也上升了20%，可能是因为预期日本央行在未来三年不会加息至0.2%以上。

不过，货币估值所涉及的不止货币政策。另一套购买力平价理论（以下简称PPP）认为货币和价格会发生调整，直至一篮子商品和服务的价格在所有地方趋同。本刊有一个自创的简易标准来衡量购买力平价：巨无霸指数，刚在7月20日更新。该指数用麦当劳这个卖遍全球的汉堡包（而非一篮子商品及服务）的价格差来判断各地货币是被高估还是低估。

我们的指数显示，欧元走弱可能是合理的（见图表）。整体指数假设各地巨无霸汉堡的价格应该一致，它预测欧元兑美元汇率为1.11: 1。但按GDP差异调整后的辅助指数显示，欧元兑美元应略低于平价点。按GDP调整后的指数考虑了土地和劳动力等投入品的价格差异，这些投入很难或不可能跨境交易，所以能反映本地收入。按美元-欧元平价，一个巨无霸在美国本土的价格比欧洲高出11%，但因为美国比欧洲富有，这样的价格差异也

算合理。

如此看来，对于欧元估值，这两套理论的结论是一致的。但日元却不然，根据巨无霸指数的两个指标，日元兑美元汇率被低估超过40%。（爱吃汉堡的美国人赶紧订机票去东京吧！）自今年1月以来，日元价值越发被低估，这是因为美元飙升加上美国通胀要比日本高得多。一个巨无霸在日本的含税价格为390日元，自2018年以来一直没变。而在这期间美国的巨无霸涨价了11.5%，今年1月以来涨了2.2%，现在要5.15美元。

UIP比PPP更能解释近期的货币价格走势，这并不奇怪。当汇率与利率脱节，交易员摁一下按键便可获利。如果说购买力差异带来机遇，受益的会是能改换生产地点或跨境运输货物的人和公司。这要花时间，而且不一定总是可行：跨国递送巨无霸可真是没头脑了。

即使在同一货币区，PPP也有可能失效。本刊的新指数对美国巨无霸价格的数据来源做了调整。以往我们只是从亚特兰大、芝加哥、纽约和旧金山这四个城市的餐厅收集一个平均价格。这些都是消费水平较高的地方。现在我们采用了麦当劳提供的全美中位价，它更低一些。结果美元就显得没那么强势了。我们已经把这一改变应用到所有历史巨无霸指数，但旧版的指数仍保留在线上。我们也改良了计算经GDP调整后指数的方法。汉堡经济学的爱好者们，请大快朵颐吧。

查看本刊的交互式可视化巨无霸指数，请访问economist.com/big-mac-index ■



The scorched Earth

A rising share of people are exposed to dangerously high temperatures

Climate change and population distribution are the cause

As climate-change models predicted, the frequency and intensity of sweltering days has increased recently. Records were broken in Europe last week as a heatwave gripped the continent. Britain set a new maximum temperature record of 40.3°C (104.5°F), shattering the 38.7°C set in 2019. Since the 1980s temperatures have risen in the world's cooler regions, exposing more people to stifling heat. Meanwhile, population growth has been fastest in the hottest countries, increasing the share of humanity affected.

To measure heat exposure, we combined two large data sets. The Universal Thermal Climate Index (UTCI) produced by the EU's Earth-observation programme, Copernicus, measures heat at hourly intervals, dividing the world into 865,000 grid squares. The UTCI combines data on air temperature and solar radiation with humidity and wind into a single composite "feels like" temperature measured in Celsius. We then fused these data with the population living in each grid square.

UTCI above 38°C is categorised as causing "very strong" heat stress. Temperatures above 46°C cause "extreme" stress. Just 30 minutes of very strong heat stress can imperil lives, particularly among the old. Four-fifths of the world's population have experienced at least one day of very strong heat stress—defined as at least three hours—in the past five years.

Although large swathes of Europe's population have endured heat above 38°C last week, it remains exceptional. Over the past five years, the average European has experienced such heat for just three days a year. But elsewhere it is the norm: people outside Europe endure similar conditions

for 65 days each year.

Extreme heat above 46°C is remarkably common, too. On average, it occurs for three days per year for each person on Earth. But the incidence is much higher in Africa and parts of Asia, particularly the Indian subcontinent. An average person living in these two continents has recently experienced such heat for 4.9 days a year, a 30% rise compared with 1980 to 1984.

High population growth in Africa and Asia means that heat stress is now affecting more people. The hottest countries have tended to grow the fastest since 1980. So the share of time that people have felt very strong heat stress has risen by 50%. Two-thirds of those who suffer extreme heat live in countries where average annual incomes are below \$2,000, meaning many cannot afford air-conditioning. Europeans should spare a thought for them as they swelter in the sun.

Sources: Copernicus; European Commission; World Bank; The Economist ■



炙烤地球

越来越多人曝露于危险的高温之中

原因是气候变化和人口分布

正如气候变化模型所预测的，最近高温酷热天气出现的频率和强度都提高了。随着一股热浪席卷欧洲大陆，上周欧洲录得破纪录高温。英国最高温度达到40.3℃，打破了2019年38.7℃的历史纪录。自上世纪80年代以来，世界上较凉爽地区的气温已经上升，令更多人置身于令人窒息的酷热中。同时，一些最热的国家人口增长最快，受高温影响的总人口比例因而上升。

我们综合两个大型数据集来衡量高温曝露情况。欧盟的哥白尼地球观测计划发布了“通用热气候指数”（Universal Thermal Climate Index，以下简称UTCI），把世界划分为86.5万个网格，按小时测量其中的热度。UTCI综合气温、太阳辐射、湿度和风速数据，得出一个以摄氏度为单位的综合“体感”温度。本刊再把这些数据和每个网格内的人口状况结合起来观察。

UTCI体感温度超过38℃被划为造成“高强”热应力，超过46℃则造成“极端”热应力。仅仅30分钟的高强热应力就会危及生命，特别是老年人。在过去五年中，全球五分之四的人口遭遇了至少一天（即有至少三个小时）高强热应力。

尽管上周欧洲大部分人口都忍受了38℃以上的高温，这仍属例外情况。在过去五年，欧洲人平均每年只有三天经历这样的高温。但在其他地方这是常态：在欧洲以外，人们每年有65天要忍受这类天气。

46℃以上的极端高温也非常普遍。平均而言，地球上每人每年有三天会遇上这样的高温。但在非洲和亚洲部分地区，特别是印度次大陆，碰到如此高温的几率要高得多。近年来，这两大洲的人们平均每年有4.9天会遭遇这样的高温，频率比1980至1984年间上升了30%。

非洲和亚洲的高人口增长意味着热应力现在影响着更多人。自1980年以来，最热的国家往往人口增长最快。所以人们经受高强度热应力的时间占比增加了50%。在遭受极端酷热的人口中，有三分之二生活在人均年收入低于2000美元的国家，也就是说其中很多人用不起空调。欧洲人应该关心一下这些在烈日下煎熬的人们。

资料来源：哥白尼计划；欧盟委员会；世界银行；《经济学人》 ■



People watching

The pecking order of the world's population is soon to change

As China shrinks, India continues to add citizens

The world's population is expected to reach 8bn on November 15th. But, such is the uncertainty with counting every person on the planet, that milestone may already have been reached. India is forecast to surpass China as the world's most populous country in 2023 or soon thereafter.

The UN hedges its predictions even as it makes them. A new forecast published on July 11th says that the world's population will reach 9.7bn in 2050, 800m more than it thought in 2002. By 2100 the world will contain between 8.9bn and 12.4bn people, with a 50/50 chance that its population will be shrinking.

Just a handful of countries are expected to lie behind population growth. The UN forecasts that 43% of the increase between now and 2050 will come from five: the Democratic Republic of Congo, Ethiopia, India, Nigeria and Pakistan. America will remain the third-largest country in 2050, with 375m inhabitants, after it has added another 40m people. Nigeria will add four times that number and be nearly as big as America. It will displace Indonesia as the fourth-most-populous place.

Some countries are helping the Earth's population to level out. This year 41 countries and territories are expected to lose more people than they gain from births and immigration. Ukraine's population, ravaged by war, will shrink by around 7m. The population of Europe, the world's oldest region, with a median age of 42 years, began shrinking in 2020 after peaking at 747m. By 2050 it is forecast to have 40m fewer inhabitants than it does today.

It is a safer bet that the distribution of humanity across the world will shift dramatically. Europe started on the path to population decline in the 1970s after the number of births per woman fell below 2.1—the level needed to replace people who die. It has since fallen to 1.5. Fertility in Africa, the world's youngest region, is nearly three times Europe's, and it will not fall below replacement rate until 2090. Births in Africa will increase even as the number of births per woman falls. By 2050, 25% of the world's population will be African.

These demographic shifts will have geopolitical consequences. Since 1950 China and India have been responsible for 35% of the world's population growth. But China's population is projected to begin falling as soon as this year. Although the Communist Party now allows women to have three children apiece, they average only 1.2. By 2050 the country will be 8% smaller. Meanwhile, India's population will continue growing, albeit at a gradually slower rate, peaking at 1.7bn in 2064, nearly 50% higher than in China. That will add weight to its claim to play a much greater role in world affairs.

Source: UN World Population Prospects, 2022 ■



人口观察

世界人口格局即将改变

中国人口萎缩，而印度人口将继续增长

世界人口预计将在11月15日达到80亿。不过，因为难以保证把地球上所有人逐个数一遍，这个里程碑说不定已经达到了。印度预计将在2023年或之后不久超过中国，成为世界上人口最多的国家。

联合国的人口预测精度不高。7月11日发布的一项新预测称，到2050年，世界人口将达到97亿，比它在2002年的预测增加了8亿。到2100年，世界将拥有89亿至124亿人口，有一半的可能性人口将开始减少。

预计只有一小批国家的人口会增长。联合国预测，从现在到2050年，43%的增长将来自五个国家：刚果民主共和国、埃塞俄比亚、印度、尼日利亚和巴基斯坦。美国到2050年仍将是人口第三大国，在增加4000万人之后将拥有3.75亿居民。尼日利亚增加的人口数量将四倍于美国的增长，从而接近美国的总人口规模。它将取代印度尼西亚成为人口第四大国。

有些国家正在帮助平衡地球人口。今年预计将有41个国家和地区失去的人口超过出生和移民所增加的人口。饱受战争蹂躏的乌克兰将减少约700万人。欧洲是世界老龄化最严重的地区，人口年龄中位数为42岁，欧洲人口在2020年达到7.47亿的峰值后开始萎缩。到2050年预计将比现在少4000万人。

一个更可靠的预测是，世界各地的人口分布将发生巨大变化。欧洲人口在上世纪70年代启动了通往下坡之路，当时每名欧洲女性生育孩子的数量降到了2.1这个维持总人口稳定所需的“替代率”之下。之后已不断下跌至1.5。非洲是世界上最年轻的地区，生育率是欧洲的近三倍，并且要到2090年才会低于替代率。即使每名女性生育子女的数量下降，非洲出生的人口也会增加。到2050年，四分之一的世界人口都将是非洲人。

这些人口结构上的变化将产生地缘政治后果。自1950年以来，世界人口增长的35%来自中国和印度。但预计中国人口最快在今年就会开始下降。虽然共产党现在允许生育三孩，但中国女性的平均生育子女数只有1.2个。到2050年中国人口将减少8%。与此同时印度的人口将继续增长，尽管速度会逐渐放缓，到2064年将达到17亿的峰值，比中国高出近50%。这会让印度有更大的底气主张自己在世界事务中发挥更大作用。

资料来源：联合国世界人口展望，2022年 ■



Private equity

Why leveraged buy-outs are in trouble

This downturn won't be like the last one

Held in february 2007, the 60th-birthday celebrations of Stephen Schwarzman, a private-equity magnate, captured the spirit of an age. Nothing distils the hubris of Manhattan on the eve of a financial crisis like Rod Stewart belting out “Maggie May” to a fizz-drinking crowd in Hermès ties. Within two years Mr Schwarzman’s firm, Blackstone, had lost more than 80% of its market value. Yet the striking thing is that the private-equity industry, including Blackstone, soon bounced back to enjoy a gargantuan boom. Today private equity is again on the ropes. But shifting investment patterns and higher interest rates mean it is unlikely to enjoy such a miraculous recovery.

As central banks raise interest rates and shrink their balance-sheets, markets are reeling. This year equities have suffered the worst sell-off in a generation. Things are also messy in debt markets, particularly the risky “high-yield” corners where private-equity funds gather ammunition for deals. Junk-bond yields have reached 9%.

All this raises questions about one of the biggest investing fashions of the past two decades. Private-equity assets have more than tripled over the past decade to reach \$4.6trn. Desperate for higher returns as interest rates fell, almost all pension funds, endowments, sovereign-wealth investors and life insurers piled into private assets. It is commonplace for a pension fund to have 10% of its holdings in this asset class.

Now a crunch is coming, in two ways. First, the deals done at sky-high valuations look a lot less clever. Higher costs and slowing economic growth will squeeze the profits of private-equity-owned firms. With share prices

lower it becomes harder to sell or float firms at attractive valuations. In contrast with the last boom, buy-out funds have loaded up on tech firms that are facing a bigger valuation hit than the market overall. It will take months for funds to mark down their valuations and for investors to get a clear view of the damage, but it is possible that funds raised since 2018 will struggle to return any profits of note.

The second part of the crunch relates to future investments. The industry is sitting on \$1.3trn of “dry powder” and investors are still increasing their allocations. Yet whether the business model works in the new macroeconomic environment is uncertain. Buy-outs, which involve buying firms using debt, can generate returns in three ways: through rising valuations, high leverage or improving operational performance. Today two of the three levers are impaired. As interest rates rise, reversing a long-term downward trend, it seems unlikely that asset prices will bounce back. Meanwhile, higher borrowing costs may be here to stay. Leverage is the lifeblood of buy-outs: the calculations have fundamentally shifted.

Private-equity managers will struggle to find a playbook from the industry’s 40-year history. The first cycle, in the 1980s, saw a band of pioneers capitalise on the inefficiencies of lumbering public corporations. The music stopped when credit markets, epitomised by the junk-bond king Michael Milken, crashed. Today there are few large, cheaply valued companies that are ripe for this kind of shock-therapy. Private equity recovered rapidly after the global financial crisis; by early 2011, business was back. But the most significant factor was central banks pushing interest rates to zero. Now some private-equity tycoons may hope to compensate by improving firms’ operating performance. Yet it is an open secret that many are speculators, not managers.

Who will suffer most? The first losses will be incurred by investment bankers who underwrote buy-out debt at frothy prices. But that will be

bonus-crushing, not system-shaking. Disclosure is patchy but, by our crude estimates, the five biggest American investment banks have up to \$90bn of corporate loans held for short-term purposes. Even if they were worth nothing this would knock only about 12% off the banks' total core capital. The ultimate investors face a bigger headache: they are betting on high returns from private equity to fulfil the promises they have made to retirees and other beneficiaries.

| *You stole my heart and that's what really hurts*

Best positioned of all are the private-equity firms themselves. Since the 1980s they have diversified. They often have property, credit and infrastructure businesses that are comparable in size to their buy-out activities. These areas may do well during inflationary periods. The industry's pioneers have largely retired. One who has stayed the course, Mr Schwarzman, today manages a vastly different firm, with diversified assets under management of \$915bn. For some people, the party never ends. ■



【首文】私募股权

杠杆收购为何陷入困境

这次的低迷有别于上次

私募股权巨头苏世民（Stephen Schwarzman）在2007年2月举办的60岁生日庆典代表了一个时代的精神。那是在全球金融危机的前夕，打着爱马仕领带的宾客们一边喝着香槟，一边听英国歌手罗德·斯图尔特（Rod Stewart）引吭高歌《玛吉·梅》（Maggie May）——没有什么比这幅场景更能体现曼哈顿的狂妄自大了。不到两年，苏世民的公司黑石集团（Blackstone）市值缩水超过80%。然而令人称奇的是，包括黑石在内的私募股权行业很快满血复活，迎来了巨大的繁荣。如今这个行业再次陷入困境。但不断变化的投资模式和上涨的利率意味着它不太可能像上次那样奇迹般地复苏。

随着各国央行加息和缩表，市场正变得动荡不安。今年，股市遭遇了二三十年来最严重的抛售。债券市场也混乱不堪，尤其是私募股权基金为交易积攒弹药的高风险“高收益”区域。垃圾债券的收益率已经达到9%。

所有这些都让人对私募股权提出质疑，过去20年里这是最热门的投资方式之一。过去十年，私募股权资产增长了两倍多，达到4.6万亿美元。由于利率下降，几乎所有渴望获得更高回报的养老基金、捐赠基金、主权财富投资者和寿险公司纷纷涌入私人资产。养老基金把自己10%的家当投入到这个资产类别里是家常便饭。

如今危机正以两种方式来袭。首先，以天价估值达成的交易现在看来很不明智。成本增加、经济增长放缓都将挤压私募股权持有的公司的利润。随着股价下跌，想让公司以诱人的估值出售或上市变得更加困难。有别于上一次的繁荣，这一次收购基金吃下了不少科技公司，而这些科技公司眼下面临的估值下跌比市场整体跌幅更大。收购基金需要几个月的时间来下调公司估值，投资者也需要几个月的时间才能弄清损失几何，但2018年以后筹集的基金可能很难有任何值得一提的利润回报。

危机的另一部分和未来的投资有关。该行业坐拥1.3万亿美元的“干火药”，并且投资者仍在增加配置。然而，这种商业模式能否在新的宏观经济环境中发挥作用还未可知。举债收购可以通过提高估值、高杠杆或改善经营业绩等三种方式产生回报。如今，这三种方式中有两个出了问题。随着利率上升，扭转了长期下行趋势，资产价格似乎不太可能反弹。与此同时，更高的借贷成本可能会持续下去。杠杆是收购的命脉，而计算方式已经发生了根本性的变化。

私募股权基金经理将很难从该行业40年的历史中找到可借鉴的战术指南。在上世纪80年代的第一个周期，一批先行者利用了上市公司的迟缓低效。当以垃圾债券之王迈克尔·米尔肯（Michael Milken）为代表的信贷市场崩溃时，美妙的音乐戛然而止。如今已很少有适合这种休克疗法的估值较低的大公司。全球金融危机后，私募股权迅速复苏；到2011年初，它们东山再起。但最重要的因素是当时各国央行将利率压低至零。现在一些私募股权大亨可能希望通过改善公司的经营业绩来弥补损失。但他们中的许多人都是投机者而不是管理者，这是一个公开的秘密。

谁会有最大的麻烦？首当其冲的会是以虚高价格承销收购债务的投资银行家。但这只会让他们的奖金缩水，而不会撼动整个体系。投行的信息披露残缺不全，但根据我们的粗略估计，美国最大的五家投资银行短期持有的企业贷款总共可达900亿美元。即使它们一文不值，也只会让银行的总核心资本减少约12%。终端投资者面临的问题更伤脑筋：它们正押注在私募股权上，期望它带来高回报，让它们兑现对退休人员和其他受益人的承诺。

| *你偷走了我的心，那真的很伤人*

处于最有利地位的是私募股权公司本身。自上世纪80年代以来，它们已经走上了多元化道路。它们往往拥有与自己的收购活动规模相当的房地产、信贷和基础设施等业务。这些领域在通货膨胀时期可能表现良好。该行业的先驱们大多已经退休。坚持到底的苏世民如今经营着一家与当初截然不同的公司——管理着9150亿美元的多元化资产。对一些人来说，派对永不终结。■



When the chips are way down

After a turbocharged boom, are chipmakers in for a supersize bust?

Surging supply and softening demand are bringing the pandemic's superstar industry back to Earth

In 2021 graphics cards were hot stuff. Video-game devotees and cryptocurrency miners queued overnight to get their hands on the latest high-end offering from Nvidia or AMD, two American chipmakers. And graphics processors were far from the only sizzling semiconductors. An acute shortage of chips disrupted the production of everything from smartphones to cars and missiles, just as demand for all manner of silicon-bearing devices boomed. Last year the chip industry's revenues grew by a quarter, to \$580bn, according to IDC, a research firm. Chipmakers' market values soared. TSMC, a giant Taiwanese contract manufacturer, became the world's tenth-most-valuable company.

With demand expected to grow ever more insatiable, the time-honoured semiconductor cycle—the consequence of the lag between demand and new supply, which takes a year or two to build up—appeared to be a thing of the past. Chip firms opened up their wallets (see chart 1). TSMC and its two main competitors, America's Intel and Samsung of South Korea, invested \$92bn between them last year, a rise of 73% relative to 2019—and pledged a further \$210bn or so all told over the next two years.

Now it seems that, far from being banished, the chip cycle may instead have speeded up. Chips of all sorts are looking wobbly. On July 14th TSMC said it would be investing less than it had envisaged. Samsung has warned of stalling profits and is said to be considering dropping prices for memory chips in the second half of 2022. In June Micron Technology, an American memory-chip maker, forecast sales of \$7.2bn in the third quarter, a fifth lower than expected. TrendForce, a firm of analysts, expects memory prices

to fall by a tenth in the next three months. By one estimate, prices of graphics chips have dropped by half since January, as the cryptosphere implodes and gamers spend more time in non-virtual reality. In the euphemistic words of David Zinsner, Intel's chief financial officer, the rest of the year is looking "a lot noisier than it was even a month ago".

As the turbocharged boom risks turning into a supersize bust, the share prices of the world's chipmakers have slumped by about a third this year (see chart 2), half as much again as the S&P 500 index of big American firms. Added to that, geopolitical tensions risk splitting up a global market and shattering complex supply chains. The pandemic's superstar industry suddenly appears a lot less stellar.

Start with supply. One way that firms have been adding capacity is by installing new kit in existing fabs (as chip factories are known). In the second half of 2021 global spending on equipment to etch chips onto silicon wafers jumped by about 75% compared with pre-covid levels, estimates Malcolm Penn of Future Horizons, another research firm. It takes a year or so for such investments to translate into new output, so late 2022 could see a production glut.

Firms can also build all-new fabs, which takes a bit longer. According to SEMI, one more research group, 34 of these came online worldwide in 2020 and 2021. Another 58 are scheduled to open between 2022 and 2024. That would raise global capacity by roughly 40%. Intel has six fabs in the works, including a \$20bn leading-edge "megafab" in Ohio, and factories in Arizona and Magdeburg, Germany. Samsung's plans include a large modern fab in Texas. TSMC is building a similar one in Arizona. Most of these are expected to begin producing chips by 2025.

There was always the risk that demand might have faded by then. But the hunger for chips has waned faster than expected. The clearest signs are in

the market for personal computers (PCs), which account for about 30% of overall demand for chips of all varieties. After a pandemic boost as working and schooling from home became the norm, global PC shipments will fall by 8% this year, reckons IDC. That is partly because some of those pandemic purchases had simply been pulled forward. Sales of smartphones, another 20% of demand, are expected to ebb, too. In April smartphone shipments in China, the world's biggest market, were a third lower than in the same month last year. The slowdown in PC and phone sales will be sharper still if the world economy dips into recession.

Data centres and carmaking consume around one-tenth of the world's chips apiece. Demand is not forecast to fall this year. But signs of softness can be seen. Chinese orders for server chips, which power data centres, have dropped off. Many panicked carmakers, for their part, have double- or triple-ordered chips to avoid the sort of shortages that forced them to cut output last year. Stacy Rasgon of Bernstein, a broker, points out that in the past few quarters shipments of automotive chips have been about 40% higher than what you would expect based on the number of cars shipped and the number of chips in a typical car. Big stockpiles in the car industry may mean a sudden drought of new orders.

The downward pressure on prices may be compounded by another powerful force. Political considerations, both domestic and international, increasingly influence chip supply and demand. On the supply side, last year's crunch spooked governments and reminded those in the West that 75% of all semiconductors come from Asia. Many now want to bring the manufacture, especially of leading-edge chips deemed of strategic importance, within their borders. In America, Congress is wrangling over the chips Act, which, if enacted, would hand the industry up to \$52bn over five years in subsidies and research-and-development (R&D) grants. The EU's version offers €43bn (\$43bn) until 2030. India, Japan and South Korea have similar schemes. So does China, which launched a semiconductor

policy in 2014.

State largesse could lead to more overcapacity. And interventionism may further dent the outlook. A chip industry fragmented along national borders would risk wasteful duplication, driving up costs for consumers. A report by BCG, a consultancy, and the Semiconductor Industry Association, a lobby group, finds that in a scenario where semiconductor production is self-sufficient within regions chip prices would increase by between 35% and 65%.

America's government seems intent on constricting demand in another way. It is using export controls to deny Chinese buyers access to semiconductors and the tools needed to make them. The urge is understandable: China is an authoritarian challenger to the American-led, rules-based global order. Awkwardly for chipmakers, China is also the world's biggest chip market. TSMC and Intel have already lost Chinese customers as a result of American restrictions. Others, such as Qualcomm, note in their annual reports that Chinese clients are developing their own chips or switching to local suppliers, in part because of geopolitical tensions. American chipmakers warn that their large R&D budgets would be difficult to sustain if they lost Chinese custom.

Political considerations are a headache for others in the semiconductor value chain, too. On July 5th Bloomberg reported that ASML, the Dutch monopolist in the market for the \$100m lithography machines used to etch high-end chips, was under pressure from America's government to stop selling its gear to Chinese firms. China accounts for 15% of ASML's sales; its share price fell by 7% on the news. The market values of ASML's American suppliers, such as Azenta and MKS Instruments, also slid. Other American toolmakers, such as Applied Materials, KLA and Lam Research, derive a third of their revenue from Chinese customers. All are in talks with American authorities to limit their sale of high-tech tools to China.

The chip bust may be softened if the drive for silicon self-reliance sputters. Continuous subsidies would be needed to keep American fabs at the cutting edge. That, in turn, would require sustained interest from easily distracted policymakers. This month Intel said it would push back the opening of its fabs in Ohio, blaming delays in passing the chips Act. TSMC has said it may need to slow the construction of its Arizona fab for the same reason. In April Morris Chang, former chairman of TSMC, bluntly called America's attempt to reshore chip production an "exercise in futility", pointing to high costs and the lack of engineering expertise.

Indeed, take out the state intervention and dips in chip cycles have been getting shallower of late, notes Ajit Manocha, who heads SEMI. That may be in part because the industry has become more consolidated. In the 1980s 20-odd firms jostled in the market for memory chips. Today it is dominated by three: Micron, Samsung and SK Hynix. At the cutting edge of microprocessor-making, Intel, Samsung and TSMC are the only firms capable of churning out the most advanced kit, down from nearly 30 firms in 2001. Fewer firms control a greater share of capital expenditure and can rein it back in if supply outstrips demand. This will require the chipmakers to rediscover capital discipline—something they have not had to exercise in a while. ■



芯片低谷

爆发式繁荣过后，芯片制造商迎来超级大萧条？

激增的供应和疲软的需求正在把疫情期间的超级明星产业拉回地面

显卡在去年火了一把。电子游戏迷和加密货币矿工彻夜排队抢购美国芯片制造商英伟达或AMD最新款高端产品。但图形处理器远不是唯一抢手的半导体。芯片荒妨碍了从智能手机到汽车和导弹的各种产品的生产，与此同时对芯片设备的需求却激增。据研究公司IDC称，去年芯片行业的收入增长了四分之一，达到5800亿美元。芯片制造商的市值飙升。代工巨头台积电一跃成为全球市值第十大企业。

半导体周期是新供应（通常需要一到两年才能建立起来）滞后于需求的结果。随着人们预计需求会越来越难以满足，这种由来已久的周期好像成了过去式。芯片公司纷纷打开钱袋子（见图表1）。去年，台积电及其两大主要竞争对手——美国的英特尔和韩国的三星——总共投资了920亿美元，比2019年增长了73%，并承诺未来两年再投资约2100亿美元。

现在看来，芯片周期非但没有消除，可能还加快了进程。各种芯片看起来都陷入了风雨飘摇之境。7月14日，台积电表示其投资将低于之前的设想。三星发出了利润增长可能停滞的警告，据说它正在考虑下调今年下半年存储芯片的价格。6月，美国存储芯片制造商美光科技（Micron Technology）预测第三季度销售额为72亿美元，比预期低五分之一。分析公司TrendForce预计，未来三个月存储芯片价格将下降十分之一。据一项估计，由于加密货币市场崩盘，以及游戏玩家把更多时间花在非虚拟现实上，显卡价格自今年1月以来已经下跌了一半。英特尔首席财务官大卫·津斯纳（David Zinsner）委婉地表示，今年剩下的几个月看起来“甚至会比一个月前还要动荡得多”。

随着爆发式繁荣可能转变为超级大萧条，全球芯片制造商的股价今年已经下跌了约三分之一（见图表2），比囊括美国大公司的标普500指数的跌幅高出一半。此外，地缘政治紧张局势可能割裂全球市场并破坏复杂的供应

链。这个新冠疫情期间的超级明星产业骤然失去了光彩。

先说供应。企业提高产能的一种方式是在现有晶圆厂（即芯片工厂）内开设新的生产线。另一家研究公司未来视界（Future Horizons）的马尔科姆·佩恩（Malcolm Penn）估计，2021年下半年全球芯片蚀刻设备的支出相比新冠疫情爆发前跃升了约75%。这些投资转化为新产能需要一年左右的时间，因此2022年底可能会出现产能过剩。

企业也可以建造全新的晶圆厂，耗时要更久一些。根据另一家研究机构国际半导体产业协会（SEMI）的数据，2020年和2021年间全球共有34座新晶圆厂投用。2022年至2024年计划再开张58座。这将使全球产能提高约40%。英特尔有六座在建晶圆厂，包括位于俄亥俄州、投资200亿美元的尖端“超级晶圆厂”，以及位于亚利桑那州和德国马格德堡（Magdeburg）的工厂。三星的计划包括在得克萨斯州建造一座大型现代化晶圆厂。台积电正在亚利桑那州建造一座类似的工厂。这些大型工厂大多预计在2025年投产。

到了那会儿，需求可能已经消退了。这种风险一直都存在。但目前市场对芯片需求的下降速度已快于预期。表现最明显的是PC市场，它约占各类芯片总需求的30%。IDC认为，新冠疫情让居家办公和上网课成为常态，带动了全球PC出货量的增长，而其销量在今年将下降8%。这在一定程度上是因为疫情提前释放了部分购买力。占芯片总需求20%的智能手机的销量预计也会下降。在中国这个全球最大的智能手机市场，今年4月智能手机的出货量同比下降了三分之一。如果世界经济陷入衰退，PC和手机销量的下滑将加剧。

数据中心和汽车制造业分别消耗了全球约10%的芯片。预测今年的需求不会下降，但已显露出疲软的迹象。中国订购的数据中心的服务器芯片已经减少。至于许多惊慌失措的汽车制造商，他们订购了两倍或三倍的芯片，以避免像去年那样因芯片短缺而被迫减产。经纪公司盛博的斯泰西·拉斯冈（Stacy Rasgon）指出，过去几个季度，汽车芯片的出货量已经比人们根据汽车出货量以及一辆车通常需要的芯片数预计出的高40%左右。汽车

行业大量的芯片库存可能会导致新订单突然枯竭。

另一股强大的力量可能会加剧价格的下行压力。国内和国际的政治考量对芯片供需的影响越来越大。在供应方面，去年的芯片危机吓坏了各国政府，同时也给西方国家提了个醒，那就是75%的半导体来自亚洲。许多国家现在希望将制造业迁回本土，尤其是被认为具有战略重要性的尖端芯片。在美国，国会正在为芯片法案争论不休，该法案一旦通过，将在五年内向芯片行业提供高达520亿美元的补贴和研发经费。欧盟版的芯片法案则计划在2030年前提供430亿欧元（430亿美元）。印度、日本和韩国都有类似的计划。中国也一样，它在2014年出台了针对半导体产业的政策。

政府的慷慨可能导致更大的产能过剩。而干预政策可能会进一步损害芯片产业的前景。如果各国芯片产业以边境为界各自为政，那将面临重复浪费的风险，从而推高消费者担负的成本。波士顿咨询公司和游说团体半导体工业协会（Semiconductor Industry Association）的一份报告发现，如果半导体生产在各区域内部实现自给自足，芯片价格将上涨35%到65%。

美国政府似乎决心用另一种方式来抑制需求。它正在利用出口管制来阻止中国买家获得半导体及其制造设备。这种急切可以理解：中国的威权主义对由美国领导的基于规则的全球秩序构成挑战。然而令芯片制造商尴尬的是，中国又是全球最大的芯片市场。由于美国的限制，台积电和英特尔已经失去了中国大陆客户。高通等其他公司在年报中指出，中国客户正在自主研发芯片或转向本土供应商，部分原因是地缘政治局势紧张。美国芯片制造商警告称，如果失去中国客户，他们的巨额研发预算将难以为继。

政治考量也让半导体价值链中的其他企业伤脑筋。据彭博7月5日报道，荷兰的阿斯麦公司（ASML）受到来自美国政府的压力，要求它停止向中国公司出售设备。阿斯麦在用于蚀刻高端芯片的一亿美元一台的光刻机市场上处于垄断地位。中国在它的销售额中占15%。消息传出后，公司股价下跌了7%。Azenta和万机仪器（MKS Instruments）等阿斯麦的美国供应商的市值也随之下滑。其他美国设备制造商，如应用材料公司（Applied Materials）、KLA和泛林集团（Lam Research），有三分之一的收入来自

中国客户。这些公司都在与美国当局就限制向中国出售高科技设备展开协商。

如果推动硅片自主生产之路并不顺利，芯片业的萧条可能会有所减缓。要保持美国晶圆厂走在最前沿，需要持续的补贴。这转而又需要政策制定者的持续关注，而他们很容易分神。英特尔本月表示将推迟俄亥俄州晶圆厂的开工时间，并将此归咎于芯片法案迟迟没有通过。台积电曾表示，出于同样的原因，它可能需要放慢亚利桑那州工厂的建设进度。今年4月，台积电前董事长张忠谋直言不讳地指出，美国试图让芯片生产回流国内的做法是“徒劳无功之举”，原因是成本高且缺乏工程技术。

实际上，去除政府干预的部分，芯片周期中的衰退期近年已经变得平缓，SEMI的负责人阿吉特·马诺查（Ajit Manocha）指出。部分原因可能是行业的整合度提高了。上世纪80年代，存储芯片市场有20来家公司相互竞争。如今，该行业由美光、三星和海力士（SK Hynix）这三家公司主导。在最前沿的微处理器制造方面，目前只有英特尔、三星和台积电三家公司有能力生产最先进的产品，而在2001年有近30家。如今，更少的公司掌握着更大份额的资本支出，能够在供过于求时悬崖勒马。这将要求芯片制造商重拾资本约束——在它们得以放松了一小段时间之后。■



Blocked and reported

With or without Elon Musk, Twitter is overdue a shake-up

Behind a stagnation in users lies a stagnating product

Elon Musk's acquisition of Twitter was to be one of the biggest buy-outs in corporate history. Now it threatens to become one of the ugliest disputes. On July 12th Twitter sued Mr Musk in a Delaware court for pulling out of the \$44bn deal, as the world's richest man—and holder of Twitter's sixth-most-followed account—took to the internet to engage in battle by meme.

The argument may play out over months. But whoever prevails in court, Twitter has bigger problems to reckon with. Though it is one of the world's most talked-about social networks, it has struggled to turn that clout into a successful business. Whoever ends up owning the app will press its managers for change.

When the sale was agreed in April, Mr Musk's offer of \$54.20 per share looked cheap—including to Twitter's board, which at first wasn't interested. No sooner had the deal been struck than tech markets crashed. On July 11th Twitter shares were trading at under \$33, having shed another 11% in value as investors lost hope that the deal would happen (the share price has rebounded a bit since). Mr Musk claims to be pulling out because Twitter has more spam accounts than it told him. Many detect a simple case of buyer's remorse.

For that reason Twitter probably has the upper hand in court. If the judge takes its side, Mr Musk faces a break-up fee of \$1bn, as specified in the contract. He may consider that a victory. The judge could go as far as ordering the sale to go ahead at the agreed price; in 2001 the same Delaware court ordered Tyson Foods (a firm dealing in real rather than digital bird) to complete its purchase of IBP, a beefpacker. That deal, though, was worth

less than a tenth as much as the Twitter purchase. And no one is sure what would happen if the mercurial Mr Musk simply defied an order to complete the acquisition. The dispute may yet be settled out of court, with Mr Musk paying a higher break-up fee or buying the company for less than the price he agreed.

However the saga ends, Twitter's bosses will face the same puzzle they have contended with for years: how to turn their influential product into a more profitable one (see chart). Part of the problem is a failure to attract new users—and not of the bot variety against which Mr Musk has railed. While Facebook, founded just two years before Twitter, has soared to 1.9bn daily users, Twitter has reached 230m and is growing only slowly. Upstarts, notably TikTok, have lapped it.

Behind that stagnation in users lies a stagnating product. Whereas Facebook and other social apps have evolved, Twitter today is a similar experience to when it launched in 2006. It had a chance to innovate when it bought Vine, an app which popularised short video four years before any TikTokers showed off their dance moves, but allowed it to wither. It tried to copy Snapchat's and Instagram's disappearing posts with "Fleets", but the idea flopped and was killed off last year.

Lately Twitter has been bolder, with some success. "Spaces", a live-audio feature, has proved popular enough to largely kill off Clubhouse, the app that inspired it. It has devised features to retain star creators, like tipping and pay-to-follow accounts. And it has pushed into longer-form content with the purchase last year of Revue, a Substack-esque paid-newsletter platform, and the launch in June of Notes, a way to write tweets of up to 2,500 words.

Monetising these and other innovations may prove harder. Over the years Twitter's revenue growth has been even more disappointing than its

growth in users. This year it will account for about 0.9% of worldwide digital-ad spending, estimates eMarketer, a research firm. Facebook and its sister company, Instagram, will grab 21.5%; even TikTok, just five years old, will take a slice worth 1.9%.

A weakening ad market has sent social-media firms scrambling to diversify their revenue; nearly 90% of Twitter's comes from advertising. Twitter Blue, a subscription option launched last year, offers modest benefits including an "undo tweet" button for \$2.99 a month. Mr Musk had wanted to push subscriptions, tweeting in April that Twitter Blue should be ad-free. Yet an ad-free Twitter would have to cost much more than \$2.99 if it were to match the current model. Twitter's accounts suggest that American users each bring in over \$6 a month in ad revenue, on average. And unlike other subscription businesses which can eschew mass audiences in favour of small, high-paying ones, Twitter needs lots of users to produce its buzzy content.

Private ownership by a famous risk-taker looked for a while as if it might enable the kind of shake-up that Twitter needs. Instead the Musk affair looks like another distraction from the task at hand. ■



审查互联网

无论马斯克入局与否，推特早该求变

用户增长停滞的背后是产品的停步不前

马斯克收购推特原本将成为商业史上最大的收购案之一，现在却很可能沦为了一场最丑陋的争吵。就在这位推特上粉丝数排名第六的世界首富用表情包大打口水仗之时，推特在7月12日就他退出这笔440亿美元的交易将他告上了特拉华州的法庭。

这场争端可能会持续数月。但无论谁在法庭上获胜，推特都需要面对更大的问题。尽管它是世界上最热门的社交网络之一，却一直未能将这样的影响力转化为商业成功。无论谁最终拥有这款应用，都将会敦促其管理层做出改变。

在4月达成收购协议时，马斯克每股54.20美元的出价看起来还很便宜——推特董事会也这么觉得，所以一开始也没动心。交易刚刚达成，科技股便全面崩盘。7月11日，推特股价跌破33美元，而随着投资者对收购将最终完成丧失希望，股价又再下跌了11%（此后略有反弹）。马斯克声称退出交易是因为推特的虚假账户比公司向他披露的要多。在很多人看来，其实就是买完又反悔了而已。

因此，推特可能会在法庭上占上风。如果法官支持推特，马斯克将面临支付合同规定的10亿美元分手费。这对他来说或许也是赢了。因为法官也可以下令按约定价格完成交易；2001年，该特拉华州法院曾命令泰森食品（Tyson Foods，它经营真正的家禽产品而不是数字小蓝鸟）完成对牛肉加工公司IBP的收购。不过，那宗交易的金额还不到收购推特的十分之一。而且，如果善变的马斯克拒不执行完成收购的裁决，没人知道这事会如何收场。这场争端仍有可能在庭外和解：马斯克要么支付更高的分手费，要么以低于之前谈妥的价格完成收购。

无论这场大戏结局如何，推特的老板们都要面对他们已苦斗多年的难题：

如何将这款有影响力的产品转变为更能赚钱的产品（见图表）。其中一大问题是难以吸引到新用户——而且不能是马斯克抨击的那类僵尸用户。只比推特早两年成立的Facebook日活跃用户数量已飙升至19亿，而推特只有2.3亿，且增长缓慢。以TikTok为代表的后起之秀也已经超过了它。

用户增长停滞的背后是产品的停步不前。Facebook和其他社交应用都在不断演变，但推特现在的体验却与2006年推出时差不多。推特收购Vine时曾有创新的机会。在TikTok用户开始大秀舞姿的四年前，这款应用就已经普及了短视频，但推特却任由它凋零。它曾试图用“Fleets”模仿Snapchat和Instagram的阅后即焚功能，但并不成功，在去年关停。

推特近来变得大胆了些，并取得了一些成功。音频直播“Spaces”颇受欢迎，基本上打败了它的模板Clubhouse。它设计了各种功能来留住明星创作者，例如打赏和付费关注账户。去年它收购了Revue（类似于Substack的付费新闻通讯平台），并在今年6月推出Notes功能，让用户可撰写最多2500字的推文。

要把这些功能和其他创新变现可能更难了。多年来，推特的收入增长甚至比用户增长更令人失望。据研究公司eMarketer估计，今年它将仅拿到全球数字广告支出的0.9%左右。Facebook及其姊妹公司Instagram将拿走21.5%，就连才成立五年的TikTok也将斩获1.9%的份额。

广告市场疲软促使社交媒体公司争相推动收入多元化，而推特近90%的收入都来自广告。去年推出的每月2.99美元的订阅功能Twitter Blue提供的福利不多，包括一个“撤回推文”按键。马斯克曾希望推动订阅付费模式，在4月发推表示Twitter Blue应该没有广告。然而，若要与当前模式的收入相当，无广告Twitter的服务价格必须远高于2.99美元。推特的账目显示，美国用户人均每月带来超过6美元的广告收入。而且，其他公司的订阅业务可以避开大众而聚焦少数高付费用户，但Twitter不同，它必须依靠大量用户来生成热门话题。

改由一位声名大噪的冒险家来私人持有一度似乎可以带来推特所需的变

革。现在看来，马斯克唱的这一出似乎只是给这项紧迫的工作又添了一次乱。■



I'm in heaven

The James Webb Space Telescope opens for business

Astronomy will never be the same again

As sites for celestial photoshoots go, the “Cosmic Cliffs” (above) were always going to be a safe bet. These stunning, textured peaks of dust and gas in the Carina nebula are light-years high. So the cliffs’ appearance last week at the release of the James Webb Space Telescope’s (JWST) first images was no great surprise. The JWST’s predecessor, the Hubble Space Telescope, snapped the same region in 2005.

The difference between these vistas could not be more striking. The JWST, the largest space telescope ever built, has already spotted baby stars among the peaks that no previous observatory could manage. Last week’s snaps give just a hint of the thrilling programme of science to come.

The telescope was launched, after 11 years of delays and at a cost of \$9.7bn, on Christmas Day 2021. Its ballooning budget, even when split between NASA and the space agencies of Europe and Canada, almost got it cancelled. But it was too big to be sunk. Before lift-off, Thomas Zurbuchen, NASA’s head of science, told *The Economist* that “The last thing we want to do is save a billion dollars and fail.”

Seven months into the mission, every aspect of launch, deployment and performance seems to have gone according to plan, if not better. As a result, astronomers now have the most powerful tool yet given them to scan the cosmos in infrared frequencies of light. That will let them study many things they have struggled to examine in the past—in particular, the formation of stars and planets, from the universe’s youth to the present day.

| *Heat and dust*

After its launch, the JWST manoeuvred its way to Lagrange 2, a point in space 1.5m km away where the gravitational fields of the Earth and the Sun conspire to create a gravity well. Here the alignment of the Earth and the Sun are such that the JWST's shield can block illumination from both—a necessity, for the telescope's infrared-detecting instruments need to be kept cold.

The JWST's potential lies in a combination of its sheer size (its primary mirror, of gold-plated beryllium, is 6.8 metres across) and the cleverness of those four well-chilled detectors.

These are MIRI (which detects long infrared wavelengths), NIRCам and NIRSpec (which take images of and analyse short-wave infrared) and FGS/NIRISS (which studies bright targets such as nearby stars orbited by exoplanets).

The wavelengths examined by MIRI correspond to objects such as exoplanets with no internal source of heat, and hotter but more distant bodies whose light has been stretched from visibility into the infrared by the expansion of the universe.

Given that “farther away” also means “longer ago” in cosmic terms, this will enable it to spot signs of the cosmic dawn, the moment when the universe's first stars ignited. A “deep-field” image also released last week (pictured above) is the first glimpse of that power; in it are features whose light set off more than 13bn years ago.

The infrared light that is the JWST's speciality penetrates dust clouds more successfully than visible light can, thus tearing away the veil from intriguing pockets of the sky where dust is coalescing into stars and planets—places such as the Cosmic Cliffs.

The accuracy of the JWST's launch meant midcourse corrections to put the telescope in orbit used less fuel than budgeted. That leaves more for the small adjustments needed to keep the instrument on station. Given that station-keeping is the main constraint on mission length, that matters. The initial goal was ten years, but NASA now reckons it can keep the telescope in place for 20. On top of this, all four instruments appear more sensitive than modelled, and thus capable of collecting 10-20% more photons than expected.

The release of last week's clutch of images marks the conclusion of the telescope's commissioning, a lengthy process intended to make sure it is fit for purpose. It is. Management will now be transferred to the Space Telescope Science Institute in Baltimore, which will have the thankless task of allocating time on it to eager astronomers. The good news is that the new estimates of its working life mean many more requests will eventually be fulfilled. The bad is that there may be a long wait. ■



神游天外

詹姆斯·韦伯太空望远镜开业啦

天文学从此再不一样

说起天体照片的拍摄目标，“宇宙悬崖”（见上图）总是稳妥的选择。它们是船底座星云内的尘埃和气体形成高达几光年的“山峰”，壮丽而层叠错落。所以当这些悬崖出现在上周由詹姆斯·韦伯太空望远镜（James Webb Space Telescope，以下简称韦伯望远镜）拍摄的首批图像中时，并没有引起太大的惊喜。韦伯望远镜的前身哈勃太空望远镜在2005年拍摄过同一区域。

但两者拍摄到的景象的差异再明显不过。作为迄今最大的太空望远镜，韦伯望远镜已经观测到了这些星云“山峰”中的年轻恒星，这是以往任何天文台都做不到的。上周发布的照片只是惊鸿一瞥，预示着这一科学项目即将带来更多激动人心的发现。

延误11年后，耗资97亿美元的韦伯望远镜终于在2021年圣诞节发射升空。即使有美国国家航空航天局（NASA）与欧洲及加拿大的航天机构共担费用，不断膨胀的预算还是险些让这个项目半途而废。但宏大的规模让它难以被舍弃。在韦伯望远镜升空前，NASA的科学事务负责人托马斯·祖布臣（Thomas Zurbuchen）告诉本刊：“我们最不希望的就是省下了十来亿但项目失败了。”

现在该项目已经启动了七个月，从发射、部署到性能的方方面面看起来至少都按计划推进（如果谈不上超预期的话）。如此，天文学家拥有了迄今最强大的工具来用红外波段观测宇宙。这将使得他们可以研究许多在过去难以探究的问题，尤其是从宇宙年轻时期迄今的时间段里恒星和行星是如何形成的。

| 热与尘

发射升空后，韦伯望远镜航行至150万公里之外的拉格朗日L2点，这里是

地球和太阳的引力场共同形成的一个引力井，其与地球及太阳的相对位置使得韦伯望远镜的隔热罩能把太阳光和地球反射光都挡住——这是必须的，因为望远镜的红外探测仪器需要保持低温。

韦伯望远镜的潜力来自于它庞大的体积（其铍制镀金主反射镜直径为6.8米）结合以四个得到良好冷却的探测器的观测能力。

它们分别是中红外仪（MIRI，探测长波红外线）、近红外相机（NIRCam）和红外光谱仪（NIRSpec，拍摄并分析短波红外图像）以及精细制导传感器/近红外成像无缝隙光谱仪（FGS/NIRISS，观测明亮目标，比如被系外行星环绕的邻近恒星）。

MIRI探测的波长来自无内部热源的系外行星以及更热但更遥远的天体等，后者发出的可见光因宇宙膨胀被拉伸为红外线。

在宇宙语汇中，“更远”也就意味着“更久以前”，所以这将使得韦伯望远镜能发现宇宙黎明时期（也就是宇宙首批恒星燃亮之时）的痕迹。同样是上周发布的一张“深场”图像（见上图）首次窥探到这股力量，其中一些天体的光芒发射自130多亿年前。

韦伯望远镜精于运用红外仪器探测宇宙，红外光波比可见光更能穿透尘埃云，因此扯开了一道纱幕，能清楚探入天空中由尘埃凝聚成恒星和行星区域的胜景，比如“宇宙悬崖”。

韦伯望远镜的发射非常精准，使得把望远镜送进轨道的中途校正所耗费的燃料低于预算。这就为仪器保持位置不变所需的小幅调整留下了更多燃料。这非常重要，因为保持固定位置是对望远镜执行任务时长的主要限制。最初的目标是十年，但NASA现在估计可以让韦伯望远镜保持原位二十年。此外，四台探测仪器的灵敏度似乎都比模拟时更高，因而能比预期多收集10%至20%的光子。

上周发布的这批图像标志着为确保韦伯望远镜正常运作的漫长调试期结束。现在，美国巴尔的摩的太空望远镜科学研究所（Space Telescope

Science Institute) 将接管它，负责向跃跃欲试的天文学家分配韦伯望远镜的使用时间——一项吃力不讨好的任务。好消息是，对韦伯望远镜工作寿命的新估计意味着更多的使用需求最终都能安排上。坏消息是，轮候时间也许会很长。 ■



Free exchange

Are central banks in emerging markets now less of a slave to the Fed?

The third in our series on the central-bank pivot

In America and Europe, central banks turned only recently from encouraging economic recovery to battling stubborn inflation. In some emerging markets this shift began much earlier. Brazil's central bank raised interest rates by three-quarters of a percentage point back in March 2021, 15 months before the Federal Reserve did the same. It foresaw that fiscal stimulus in the rich world raised the risk of inflation, which would upset financial markets and complicate life for emerging economies. The governor of Russia's central bank, Elvira Nabiullina, warned over a year ago that the prospect of sustained inflation was likelier "than perceived at first glance". The pandemic had changed spending patterns, she pointed out. No one knew if the shift would last. But that very uncertainty was discouraging firms from investing to meet demand.

These kinds of comments look prudent and prescient in hindsight. Indeed, with some notable exceptions, central banks in emerging markets have won increased respect in recent years. Their monetary-policy frameworks have improved, according to a new index (based on 225 criteria) developed by the IMF. Their frameworks are more coherent (their targets serve sensible objectives), transparent (they say what they are doing) and consistent (they do what they say). According to calculations by the World Bank, expectations of inflation in emerging markets in 2005-18 were about as well-anchored as they had been in rich countries in 1990-2004. Inflation also became less sensitive to falls in the exchange rate. Your columnist remembers a sign outside a café in the Malaysian state of Penang in 2015. "Don't worry!" it said. "As our ringgit falls, coffee price remains the same."

More people expected emerging markets to succeed in their fight against

inflation, which in turn made success more likely. This enhanced credibility raised enticing possibilities. Perhaps their central banks, like those in the rich world, would not need to worry about each depreciation and every inflation spike. If so, perhaps they could pay less slavish attention to two forces that had bedevilled them in the past: namely, the global price of capital, which is dictated by the Fed, and that of commodities.

When the Fed tightens monetary policy, trouble has often followed for emerging markets. In 2013, for example, Ben Bernanke's talk about reducing (or tapering) the pace of the Fed's bond-buying sparked the "taper tantrum", a big sell-off in Brazil, India, Indonesia, South Africa and Turkey. Things are different in the rich world. When the Fed tightens, central banks in Britain, the euro area and Japan do not feel obliged to raise interest rates. Their currencies may fall. But unless these depreciations look likely to raise inflation persistently above their targets, they are ignored. Likewise, when the price of oil goes up, so does the cost of living. Yet consumer prices need not go on rising, unless people demand higher wages in response, putting further upward pressure on prices in a self-reinforcing spiral. In both cases, central banks can ignore a one-time increase in prices. The more securely inflation expectations are anchored, the more leeway central banks enjoy.

The past year has subjected emerging-market anchors to one severe test after another. Global interest rates have risen in anticipation of a faster pace of tightening in America, as the Fed wrestles with a credibility test of its own. And emerging markets have suffered remorseless increases in the prices of food and fuel, which make up more of their consumers' shopping bills than they do in the rich world. According to the World Bank, food and energy account for over 60% of South Asia's consumer-price index.

Some central banks have been able to "look through" the rise in food and fuel prices. One example is Thailand's central bank, which has done

nothing even as inflation has surged. It insists that “medium-term inflation expectations remain anchored,” and it wants to make sure the economic recovery gains traction. But other emerging markets, including Mexico and Brazil, felt compelled to raise interest rates forcefully long before their economies fully recovered. They were quicker to respond than their counterparts in mature economies, point out Lucila Bonilla and Gabriel Sterne of Oxford Economics. But “that’s partly because they had to be.” Much of their tightening had to keep up with a worrying rise in inflation expectations. They have stayed ahead of the curve. But the curve has been brutally steep.

The Fed has been a “somewhat less dominant” force in this emerging-market tightening cycle than in the past, note Andrew Tilton and his colleagues at Goldman Sachs. Fears of a second taper tantrum have not been realised. One reason may be that a lot of footloose foreign capital had already left during the pandemic. Moreover, some of the countries that might otherwise be vulnerable to Fed tightening, especially those in Latin America, are also big commodity exporters that have benefited from higher prices for their wares, point out Ms Bonilla and Mr Sterne.

| *Following the leader*

The Fed, however, is far from finished. And inflation, already rising in emerging markets, may become more sensitive to any falls in domestic currencies. “It’s like adding combustible material to a fire,” says David Lubin of Citigroup, a bank. A depreciation may not be enough to ignite inflation. But once it is already burning, a weaker exchange rate could make it hotter. A Malaysian café that is already revising its prices to keep up with costlier commodities may be more likely to factor in a weaker ringgit.

Much therefore depends on how far the Fed has to go to restore its anti-inflation credentials and contain price pressures in America. The harder the Fed must work to meet the test of its own credibility, the more trouble

emerging markets will face. Their hawkish pivot began much earlier than in America, but it probably cannot end much sooner. This year has reminded emerging markets that for all their progress, they are not yet blessed with fully credible central banks. It has taught America the same lesson. ■



自由交流

新兴市场的央行不再那么受制于美联储了吗？

央行策略转向系列之三

在美国和欧洲，央行直到最近才开始从推动经济复苏转向对抗顽固通胀。在一些新兴市场，这种转向开始得早得多。巴西央行在2021年3月就将利率提高了0.75个百分点，比美联储早了15个月。它预见到富裕国家的财政刺激会增加通胀的风险，这将扰乱金融市场，让新兴经济体的日子不好过。俄罗斯央行行长埃尔薇拉·纳比乌琳娜（Elvira Nabiullina）一年多前警告称，持续通胀的前景“比乍看起来”可能性更大。她指出，疫情已经改变了消费模式。没有人知道这种转变是否会持续。但正是这种不确定性阻碍了企业为满足需求而投资。

现在看来，这类评论都很审慎且有先见之明。事实上，除一些明显的例外之外，新兴市场的央行近年来赢得了越来越多的尊重。根据国际货币基金组织制定的一项新指数（基于225项标准），它们的货币政策框架有所改善，变得更协调一致（制定合理目标）、更透明（公开自己在做什么）、更言行一致（说什么做什么）。根据世界银行的计算，2005年至2018年新兴市场通胀预期锚定的程度与1990年至2004年富裕国家的情况大致相同。通胀对汇率下跌的敏感度也降低了。本专栏作者记得2015年去马来西亚槟城的时候，一家咖啡馆外竖着一块牌子，“不用担心！”上面写道，“虽然林吉特在贬值，但我们的咖啡不涨价。”

越来越多的人预计新兴市场将在对抗通胀方面取得成功，这种预期反过来又增加了成功的几率。这种信誉的提升带来了诱人的可能性。也许这些央行和富裕国家的央行一样，不需要为每一次货币贬值和通胀飙升担心。如果是这样，也许就不必再那么亦步亦趋地盯牢过去困扰它们的两股力量，也就是由美联储决定的全球资本价格，以及大宗商品价格。

当美联储收紧货币政策时，新兴市场往往会随之遇到麻烦。例如在2013年，本·伯南克（Ben Bernanke）关于减少（或者说缩减）美联储购债规

模的言论引发了“缩减恐慌”——在巴西、印度、印度尼西亚、南非和土耳其发生了大规模抛售。富裕世界的情况有所不同。当美联储收紧政策时，英国、欧元区和日本的央行并不觉得必须提高利率。它们的货币可能会贬值，但这些央行不会太当回事，除非贬值看起来可能会让通胀持续高于目标。同样地，当石油价格上涨时，生活成本也会上涨。但消费者价格不一定会继续上涨，除非人们因此而要求涨工资，进一步对价格造成上行压力，形成自我强化的螺旋。在这两种情况下，央行都可以忽略价格的一次性上涨。通胀预期锚定得越稳，央行的回旋余地就越大。

过去一年里，新兴市场的通胀锚定经受了一次又一次的严峻考验。由于美联储正在全力应对一场对自己可信度的考验，人们预期美国会加快收紧货币政策的步伐，全球利率随之上升。新兴市场的食品和燃料价格一路上涨，它们在这些市场消费支出中的占比比在富裕国家更高。根据世行的数据，食品和能源占南亚消费价格指数的60%以上。

一些央行已经能够对食品和燃料价格的上涨“视而不见”。以泰国央行为例，在通胀飙升之时，它并没有采取任何行动。它坚称“中期通胀预期仍保持锚定”，并希望确保经济复苏能够加速。但包括墨西哥和巴西在内的其他新兴市场在其经济完全复苏之前很久就感到有必要大幅加息。牛津经济研究院（Oxford Economics）的露西拉·波尼拉（Lucila Bonilla）和加布里埃尔·斯特恩（Gabriel Sterne）指出，与成熟经济体的央行相比，这些新兴市场的央行反应更快。但“部分原因是它们不得不反应更快。”它们的大部分紧缩政策必须跟上令人担忧的通胀预期上升。它们一直都比通胀曲线先行一步。但这条曲线的升势已然非常陡峭。

与过去相比，美联储在新兴市场这一轮紧缩周期中的“主导作用有所减弱”，高盛的安德鲁·蒂尔顿（Andrew Tilton）及其同事指出。对第二次缩减恐慌的担忧尚未变成现实。一个原因可能是大量到处流动的外国资本在疫情期间已经撤离。此外，波尼拉和斯特恩指出，一些原本可能容易受到美联储紧缩政策影响的国家——尤其是拉丁美洲国家——同时也是从大宗商品价格上涨中受益的大宗商品出口国。

| 跟随领头羊

然而，美联储远远没有失去其影响力。新兴市场已经上升的通胀可能会变得对本国货币任何幅度的贬值都更加敏感。“这就像是火上浇油。”花旗集团的大卫·鲁宾（David Lubin）说。贬值可能不足以引发通胀，但如果通胀之火已经点燃，汇率进一步走低可能会让火势更旺。如果一家马来西亚的咖啡馆已经在调整价格以跟上大宗商品涨价，它把林吉特贬值也算进去的可能性或许会更高。

因此，事态的走向很大程度上要取决于美联储须做到什么地步来重塑其抗通胀的信誉及遏制住美国的价格压力。美联储在这场可信度考验中越吃力，新兴市场面临的麻烦就会越多。它们向鹰派立场的转向开始得比美国早得多，却可能没法结束得多早。今年的境遇提醒了新兴市场，不管获得了多大进步，它们仍然没有拥有完全可信的央行。它也给美国上了同样一课。■



Abenomics After Abe

The legacy of Abe Shinzo will shape Japan's economy for years

The anti-deflation arsenal of the country's most influential prime minister is still needed

A little less than eight years is not an especially long tenure for heads of government in much of the world. In Japan, it is a veritable aeon. And two years after the resignation of Abe Shinzo, a former prime minister who was assassinated on July 8th, the reforms he pushed in office look set to shape Japan's economy for years to come.

The current prime minister, Kishida Fumio, secured a big majority of seats in the upper house of Japan's legislature in the election on July 10th. His greater focus on equality and redistribution, which he calls "New Capitalism", was initially cast as an alternative to Mr Abe's vision. In reality, it will be built on the foundations his predecessor laid out. The programme which began after Mr Abe's 2012 thumping election victory—dubbed Abenomics—had three so-called "arrows" to dislodge Japan from its economic stagnation: flexible fiscal policy, monetary expansion and structural reforms.

Clear positives stand out from Mr Abe's record, most notably the financial accounts of Japan Inc. Reforms to corporate governance encouraged more shareholder-friendly activity and prodded firms to reduce moribund networks of cross-shareholdings. Those changes, paired with a slump in the yen, boosted corporate earnings to record levels (see chart). An environment friendlier to investors also helped to raise anaemic levels of inward foreign direct investment. In 2020, direct investment into Japan was worth 1.2% of GDP, the highest on record.

There have been stark improvements in the labour market, too. Japan's

female employment rates, previously low by the standards of rich economies, climbed rapidly under Mr Abe. At 72% among working-age women, the employment rate is now more than ten percentage points above the levels Mr Abe inherited, and six percentage points above the American equivalent. Kathy Matusi, the economist who championed increasing female participation as a way to unlock the productive potential of the Japanese economy, credits Abe-era reforms, such as mandatory disclosure on gender diversity and more generous salary replacements for new parents.

Mr Kishida's aides now talk less of ditching Abenomics and more of building its legacy. When his New Capitalism Council revealed its "grand design" document in May, it concluded that the strategy would adhere to the three-arrow framework. The strategy focuses, rightly, on the need to get firms to deploy their excess cash through wage increases or capital investments. Stagnant wages have been Abenomics's biggest shortcoming. At around 266,000 yen (\$1,940) per month in May, Japan's average wage has barely budged in a decade, and has actually fallen in real terms. Most of the recent rise in female employment reflects growth in part-time jobs that are usually poorly paid. This is where Mr Kishida could have the most to offer. Regrettably, his approach to the issue so far differs little from Mr Abe's: tax incentives and browbeating, with a bit of a boost for public-sector workers.

Fiscal policy was a troubled area for Mr Abe, and is likely to remain one for Mr Kishida. Two long-planned but ill-fated increases in Japan's sales tax, in 2014 and 2019, made fiscal policy a drag on the recovery rather than a boost. Spending under Mr Abe was not as flexible as the first arrow's label would have suggested. After leaving office, Mr Abe did convince the party to soften its pledge to balance the primary budget (excluding debt-servicing costs) by 2025. But Mr Kishida is said to be more concerned about fiscal sustainability. His closest advisers have backgrounds in Japan's typically hawkish finance ministry.

Mr Abe's support for a more stimulative monetary policy has also lasted beyond his tenure, with mixed effects. Enormous purchases of bonds, and a subsequent policy to directly fix the yields of government bonds, may have prevented Japan from falling back into deflation, but failed to stimulate inflation or nominal-income growth as desired. As inflation rises globally, the Bank of Japan may find it harder to keep policy easy. But Mr Kishida will likely pick a continuity candidate when Kuroda Haruhiko, Mr Abe's central-bank governor, leaves office next April.

With Mr Abe gone, might Mr Kishida feel liberated to diverge further from his predecessor? Different global conditions could fuel such a change. Concern about fiscal discipline has more truck in a world of rising interest rates. But the differences between Mr Abe's and Mr Kishida's approach now look more likely to be a matter of degree rather than substance. Mr Kishida's focus on wages, in particular, could augment the successes of Abenomics if properly pursued. Mr Abe's arrows, in short, will remain essential weapons. ■



安倍之后的安倍经济学

安倍晋三的遗产将长久塑造日本经济

日本最有影响力的首相的反通缩武器仍必不可少

对于世界大多数国家的政府首脑来说，将近八年的任期不算特别长。但在日本，这是不折不扣的超长任期。在安倍晋三（他在7月8日遇刺身亡）辞任首相两年后，他在任内推动的改革看起来仍将在未来多年里影响日本经济。

现任首相岸田文雄在7月10日的选举中获得了日本参议院的大多数席位。他提倡“新资本主义”，更注重平等和再分配，这在最初大有取代安倍路线之势。但实际上，这套新理念还是要在安倍打下的基础上发展。安倍在2012年大选中大获全胜，随后推出了被称为“安倍经济学”的方案，运用“三支箭”让日本摆脱经济停滞：灵活的财政政策、扩张性货币政策和结构性改革。

安倍的政策取得了显著成效，特别是在日本企业的财务状况上。公司治理方面的改革鼓励了更多对股东友好的活动，促使企业减少采用僵化过时的交叉持股网络。这些变化再加上日元汇率下滑令日本企业盈利升至历史新高（见图表）。对投资者更友好的环境也有助提升原本疲软的对日外国直接投资。2020年，日本的外国直接投资相当于GDP的1.2%，为史上最高。

劳动力市场也有明显改善。以富裕经济体的标准来看，日本的女性就业率过去一直较低，但在安倍任内迅速攀升。现在日本劳动年龄女性的就业率为72%，比安倍接任时高十多个百分点，比美国高六个百分点。提倡增加女性劳动参与率以释放日本经济生产潜力的经济学家松井凯西把这归功于安倍时代的改革，例如强制要求企业披露性别多样性水平，以及向新晋父母提供更慷慨的工资补贴。

岸田的手下现在不再谈论放弃安倍经济学，而更多表示要继承发扬它。岸田的新资本主义委员会在5月公布了“大设计”文件，总结称目前的战略将

遵循“三支箭”框架。该战略注重让企业把富余的现金用于上调工资或资本投资，这是对的。工资增长停滞一直是安倍经济学的最大缺陷。5月，日本平均月薪约为26.6万日元（1940美元），几乎十年没变过，按实际价值计算更是下降了。近年的女性就业率上升主要出现在通常薪酬低下的兼职职位上。这本来是岸田可以大展拳脚的环节。遗憾的是，到目前为止，他在这方面的举措与安倍没太大区别：实施税务激励和惩戒，再给公务员加点薪。

财政政策让安倍非常头疼，对岸田来说很可能也还是一样。日本分别在2014年和2019年两次上调销售税，虽然经过长时间酝酿，但都以失败告终，使得财政政策非但没有推动、反而拖累了经济复苏。安倍任内的支出政策并不像第一支箭的名字听起来那样灵活。离任后，安倍成功游说自民党软化其承诺在2025年前实现基本预算（不包括偿债成本）平衡的立场。但据说岸田更关心财政可持续性。他的心腹顾问都有日本财务省背景，这个部门往往持鹰派立场。

安倍主张更具刺激性的货币政策，这也延续至他任期之后，但结果有好有坏。大量购债及随后直接固定政府债券收益率的政策可能帮助了日本免于重陷通缩，但未能如预期般刺激通胀或名义收入增长。随着全球通胀上升，日本央行也许更难保持宽松货币政策。但岸田很可能在明年4月黑田东彦（安倍任内提名的央行行长）离任时挑选能保持政策连续性的候选人。

安倍离世后，岸田会否感到可以更无所顾忌地进一步偏离他前任的路线？改变了的全球局势可能推动这样的转变。世界各地都在加息之时，人们会更担忧财政纪律的问题。但安倍和岸田的政策如今看来更可能是程度而非本质的区别。尤其是岸田对工资问题的关注，如果处理得当，将有可能扩大安倍经济学的成果。简而言之，安倍的“箭”仍将是必不可少的武器。■



Helter skelter

Do cheaper commodities herald a recession?

Oil, metals and wheat prices are sinking

The war in Ukraine throttled a flow of raw materials that was already being restricted by logistical logjams, bad weather and other disruptions. The result was soaring prices. In March a barrel of Brent crude oil hit \$128, and European gas prices were three times higher than they had been just two months earlier. Copper, a trendsetter for all industrial metals, hit a record price of \$10,845 per tonne. Wheat, corn and soyabean prices rose by double-digit percentages. The surge turbocharged consumer-price inflation, which, by challenging central banks' credibility, has given them another reason to raise interest rates.

Yet in recent weeks the wind has changed. Oil is trading at around \$100 a barrel. Copper has dropped below \$8,000 a tonne for the first time in 18 months; metals in general have fallen by 10-40% since May. Agricultural-commodity prices are back at pre-war levels. (Europe's gas prices, which have continued to rise as Russia has cut supply, are bucking the trend.) The slide may fuel hopes that inflation will soon be defeated. But the victory might prove hollow—if there is one at all.

One explanation for tanking commodity prices is that worries about a recession are taking hold. In this view, rising interest rates are cooling the market for new homes, dampening demand for building materials such as copper and wood, and lowering spending on things like clothing, appliances and cars, which in turn hurts everything from aluminium to zinc. Moreover, some of the supply constraints that contributed to price rises earlier in the year have eased—the weather in grain-growing regions has improved, for instance. Meanwhile, the UN is trying to end a blockade on Ukraine's shipments of wheat.

For central banks, this is mixed news. It suggests that inflation may be beaten even though they have only just begun tightening monetary policy. True, this might be accompanied by a recession, but, because inflation would be tamed without interest rates having to rise too much, the downturn would, perhaps, at least be shallow.

Worries about the economy are not the only force pushing down prices. Much of the money that has fled commodities, say industry experts, belongs not to physical traders but to financial punters. In the week to July 1st about \$16bn flowed out of commodity-futures markets, bringing the total for the year so far to a record \$145bn, according to JPMorgan Chase, a bank. In part that reflects rising interest rates. In May America's long-dated real rates turned positive for the first time since 2020. That made commodities, which do not offer a yield, less attractive to speculators.

This suggests that commodity-price inflation may not have been slayed. Movements driven by real-rate swings are usually short-lived, says Tom Price of Liberum, an investment bank. The last time one happened, in 2013, prices stabilised within weeks. Prices are also still sensitive to further supply disruptions. Commodity stocks remain 19% below historical average at a time of tight production, meaning there is less of a buffer against shocks.

Even as some supply problems have eased, triggers for others abound. Energy prices are still vulnerable to Vladimir Putin's whims. Pricey energy, in turn, would cause metals producers to trim output further, making production tighter still. And the return of La Niña, a harsh climate pattern, for the third consecutive year could disrupt grain harvests worldwide. Prices, in other words, might stay high even if recession hits. ■



一团糟

大宗商品降价是否预示经济衰退？

石油、金属和小麦的价格都在跌

在物流堵滞、恶劣天气和其他干扰之后，乌克兰战争进一步阻碍了原材料的流动。结果就是价格飙升。3月，布伦特原油价格达到每桶128美元，欧洲天然气价格是两个月前的三倍。作为所有工业金属的风向标，铜价达到创纪录的每吨10,845美元。小麦、玉米和大豆的价格涨幅达到两位数。价格飙升大幅加剧了消费价格通胀，这让各国央行的信誉受到考验，给了它们另一个加息的理由。

不过最近几周风向变了。石油交易价格约为每桶100美元。铜价18个月来首次跌破每吨8000美元；自5月以来，金属价格总体下跌了10%到40%。农产品价格回归到乌克兰战争前的水平。（欧洲的天然气价格没有跟随这一风向，而是随俄罗斯停供继续上涨。）价格下滑也许会让人燃起通胀很快会被击退的希望。但即便赢下这一城，胜利也可能有名无实。

对大宗商品价格下跌的一种解释是，对经济衰退的担忧加剧。这种观点认为，加息正让新房市场降温，抑制了对铜和木材等建筑材料的需求，同时使得人们减少在服装、电器和汽车等商品上的支出，这又损害了对铝和锌等各种金属的需求。此外，导致今年早些时候价格上涨的供应吃紧已有所缓解——比如粮食产区的天气已经好转。与此同时，联合国正试着消除乌克兰小麦出口的障碍。

对于各国央行来说，这喜忧参半。这意味着即使它们刚刚才开始收紧货币政策，可能就击败了通胀。诚然，这可能会伴随经济衰退，但是既然无需加息太多就能将通胀抑制住，那么衰退可能也不会太严重。

对经济的担忧并不是压低价格的唯一力量。业内专家表示，大部分逃离大宗商品的资金不属于实物交易者，而属于金融投资者。根据摩根大通的数据，截至7月1日的一周内，约有160亿美元从大宗商品期货市场流出，今

年迄今为止的流出总额达到创纪录的1450亿美元。这在一定程度上是对加息的反应。5月，美国长期实际利率自2020年以来首次转为正值。这让不产生收益的大宗商品对投机者的吸引力降低。

这表明大宗商品价格通胀可能尚未消解。投资银行Liberum的汤姆·普莱斯（Tom Price）认为，由实际利率波动驱动的走势通常是短暂的。上一次出现这样的情况是在2013年，当时价格在几周内就稳定了下来。价格对进一步的供应中断也依旧敏感。在生产紧张的情况下，大宗商品库存仍比历史平均水平低19%，这意味着抵御冲击的缓冲不足。

在一些供应问题缓解之时，引发另一些供给问题的因素仍比比皆是。能源价格仍然容易受普京心血来潮的左右。而昂贵的能源会导致金属生产商进一步减产，继而影响其他商品的产量。恶劣气候现象拉尼娜连续第三年出现，可能会严重影响全球粮食收成。换句话说，即使经济衰退来袭，价格也可能依然保持高位。 ■



Above the water line

Fewer people are dying in floods in China

Money, dams and better planning are helping; climate change is not

As the waters submerged her village's ancestral shrine, Yu Jingyu and her family put their chickens upstairs and fled to the upper floor of their neighbour's taller house. In the bamboo-clad hills of Yingde, in the southern province of Guangdong, locals say these are the worst floods they have ever seen. The nearby river has risen to its highest level since records began in 1951. "Everything is gone," says Ms Yu, cradling her baby.

Yet there have been no reported deaths in Yingde in June and July, despite the severity of the flooding. This is telling. Between 1990 and 1999, there were more than 1,000 deaths across China from flooding and landslides every year and, in three of those years, more than 3,000. Since 2011 the toll has topped 1,000 only twice. Data are imperfect and the government tries to hide its failures. But experts agree that the downward trend in deaths from flooding is clear, even though overall levels of precipitation have remained steady and, for the past three years at least, there have been more "intense rain events".

There are a few reasons for this. First, the Communist Party has spent lavishly to respond to emergencies, especially since a devastating earthquake in 2008, says Scott Moore of the University of Pennsylvania. "High-profile disasters were perceived as being significant challenges to the Party's ability to protect the people, which of course it claims to do," he says. Political pressure means disaster response has become one of the few areas where government departments work well together, he says. Rescue efforts by heroic officials and soldiers also provide good propaganda.

The government has got much better at moving people to safety. In 2020's

rainy season, 4.7m people were evacuated from floods, nearly 50% more than the average of the previous five years. More accurate weather forecasts and fast communications are crucial. Villagers in Yingde were warned on WeChat, a ubiquitous messaging app, that a flood was coming and they should be ready to flee.

The thousands of dams and dykes built over the past few decades are also life-savers. So many of them block China's big rivers that officials are running out of good sites to build new ones. The infrastructure came with huge costs in concrete, forced resettlement and damage to the environment. But officials can now protect big cities by holding floodwaters upstream and staggering their release. Not everyone benefits. "The logic is to protect more populated regions," says Ma Jun, an environmentalist. "But this may induce a cost upstream." In Yingde some grumbled that their villages were used as a reservoir to protect Guangzhou, a city downriver.

Despite lower death tolls, China's age-old battle against floods is likely to get harder as extreme weather becomes more common. China is "probably the most exposed of any large country or economy" to climate risks, says Mr Moore. For one thing, river dams do not protect against rising sea levels. More investment in building sea walls will be needed, he says.

Upstream dams do not help much if enough rain falls directly on cities, overwhelming storm drains and sewers. Making cities more absorbent with parks and wetlands can help. China has invested billions of yuan in creating such "sponge cities". But even these struggle to cope if rains are too intense, says Faith Chan of the University of Nottingham in Ningbo. Floods that killed around 400 last year in Zhengzhou, a showcase sponge city, came after a year's worth of rain fell in three days.

And although China has reduced deaths from rising waters, it is poorly

prepared for the economic damage that they bring. Floods in 2021 caused \$23bn in losses, second only to Europe. Only 10% of those losses were insured, according to estimates by Swiss Re, a reinsurance firm. In Europe, in contrast, 32% of losses from floods were insured last year.

Ms Yu and others in Yingde say the floods have cost them tens of thousands of yuan. Most make around 3,000 yuan (\$440) a month and few have insurance. What they do possess is the stoicism of the ages in the face of tragedy. “If there’s rice we’ll eat rice,” says one. “And if there’s just porridge, then we’ll eat porridge.” ■



高于警戒水位

中国洪灾死亡人数在减少

资金、堤坝和更好的规划帮上了忙。但气候变化在添乱

洪水已经淹没了村里的祠堂，余静玉（音译）和家人把鸡赶上楼，自己躲到邻居家更高的房子的顶楼。在广东英德这片竹林密布的山丘地带，当地人说从没见过这么大的洪水。附近河流的水位已经上升到自1951年有记录以来的最高水平。“什么都没了。”轻柔怀抱着孩子的余静玉说。

不过，尽管洪灾如此严重，英德在6、7月间并没有人员死亡报道。这很能说明问题。从1990年到1999年，中国每年都有超过1000人死于洪水和山体滑坡，其间有三个年份超过3000人。而自2011年以来，只有两个年份死亡人数超过1000人。数据是有瑕疵的，政府也试图掩盖自己的失职。但专家们一致认为，洪灾致死人数下降的趋势明显，尽管总降雨水平并没有什么变化，而且至少在过去三年里“强降雨事件”还增多了。

死亡人数明显下降有几个原因。宾夕法尼亚大学的斯科特·摩尔（Scott Moore）表示，首先，共产党在应急救援上大举砸钱，尤其是在2008年一场毁灭性的地震之后。“党当然声称要保护好人民。而广受关注的灾难被看作是对这种能力的重大挑战。”他说。政治压力让救灾成为政府各部门高效合作的少数几个领域之一，他表示。英勇的官员和军人的救援行动也是很好的宣传材料。

中国政府在把群众转移到安全地带方面表现大幅提升。在2020年的雨季，政府从洪水中转移了470万人，比前五年的平均水平多近50%。更准确的天气预报和快速的通信至关重要。英德的村民们在如今人人都在使用的即时消息应用微信上收到了警报，通知他们洪水即将来袭，应做好迅速撤离的准备。

过去几十年里修建的成千上万座堤坝也拯救了生命。中国的大江大河被太多这样的堤坝阻断，官员们已经找不到合适的地方来建新的了。这些基础

设施代价巨大，包括耗费的混凝土、强行搬迁安置以及对环境的破坏。但官员们现在可以通过把洪水控制在上游并错峰泄洪来保护大城市。不是每个人都是受益者。“这么做是为了保护人口较多的地区，”环保人士马军表示，“但这可能会让上游地区受损。”在英德，一些人抱怨他们的村庄被用作了水库，来保护地处下游的广州市。

尽管死亡人数下降，但随着极端天气日益频繁，中国由来已久的抗洪斗争很可能会变得更加艰难。摩尔表示，面对气候风险，中国“可能是大国或大型经济体中受影响最大的”。一来是河坝不能防御海平面上升。需要加大投资建造海堤，他指出。

而如果大雨直接下在城市，使得雨水管道和下水道来不及泄洪，那么即便上游有大坝也无济于事。利用公园和湿地来提高城市的“吸水力”会有帮助。中国已经投入数以十亿计的资金打造这样的“海绵城市”。但如果降雨太大太急，即使这样的城市也应付不了，宁波诺丁汉大学的陈加信表示。去年，海绵城市建设试点郑州三天里下了一年的雨，约400人被洪涝夺去了生命。

此外，尽管中国的洪灾死亡人数减少了，但它对洪灾带来的经济损失却准备不足。2021年，洪水造成的损失达230亿美元，仅次于欧洲。据瑞士再保险公司（Swiss Re）估计，其中只有10%的损失已投保。而在欧洲，去年在洪灾中受损的财产有32%投了保。

余静玉和英德的其他民众说，洪水让他们损失了几万块。他们大多数月收入在3000元左右，没什么人有保险。他们真正拥有的，是长期以来面对不幸时的那种坚忍。“有饭食饭，”其中一人说，“有粥食粥。”■



Building blocs

The G7 at last presents an alternative to China's Belt and Road Initiative

Just as China starts to scale back its own scheme

In the nine years since China launched its Belt and Road Initiative (BRI), a multi-billion-dollar spree of global infrastructure-building, American efforts to counter the scheme have repeatedly faltered. Barack Obama's administration failed to persuade allies to boycott the Chinese-led Asian Infrastructure Investment Bank. Mr Obama touted a free-trade deal, the Trans-Pacific Partnership, but Donald Trump sank it in his first week in the White House.

As some countries struggled to repay Chinese loans, the Trump administration got some traction calling the BRI "debt-trap diplomacy". The scheme still accounted for about \$890bn in investment and construction contracts (many financed by Chinese loans) between 2013 and 2021, says Christoph Nedopil Wang at Shanghai's Fudan University. And every time America criticised China's "new Silk Road", the riposte came: "What are you offering instead?"

Now, just as China starts to scale back its programme, America and its allies appear to have come up with an answer. On June 26th the rich democracies of the G7 unveiled a plan to mobilise \$600bn of private and public investment in infrastructure in low- and middle-income countries over the next five years. It is called the Partnership for Global Infrastructure and Investment (PGII). President Joe Biden said his country would stump up \$200bn.

Western officials say the scheme will not compete directly with the BRI, which has focused on ports, railways and other "hard" infrastructure. Instead, it will try to play to the G7's strengths by prioritising climate and

energy security, digital connectivity, health and women's equality. In contrast to China's scheme, it promises to be transparent and sustainable—financially, environmentally and socially. Whereas China's programme mainly involves loans from state-controlled banks, the PGII will aim to use limited government resources to catalyse larger private investments. "This isn't aid or charity," Mr Biden said on the plan's launch. "It's an investment that will deliver returns for everyone."

On the face of it, the plan is bad news for China. The BRI was already facing headwinds, owing partly to excessive lending to commercially dubious projects and partly to the impact of covid-19. Pakistan, once hailed as the BRI's centrepiece, is on the brink of default. Sri Lanka, another big recipient of Chinese loans, defaulted in May. The BRI had also grown too large to manage effectively. Those problems, combined with an economic slowdown at home, have prompted a scaling back, and the steering of funds towards smaller, higher-quality projects and into "soft" infrastructure such as health care. Although the BRI will continue (it is written into the constitution), China's president, Xi Jinping, is now promoting a new idea, the Global Development Initiative, which is expected to focus more on sustainable development.

The upshot is that China's efforts will increasingly come into direct competition with the G7's. Some Chinese experts warn this will complicate Chinese strategic goals. Wang Yongzhong of the Chinese Academy of Social Sciences says that by focusing on "soft" infrastructure where they have comparative advantages, Western countries aim to boost exports of their own technology and services in areas such as 5g telecoms, blockchain and clean energy. That would allow them to "reap rich geopolitical and economic rewards", he wrote in People's Tribune, an official magazine.

A broader concern for China is that America and its allies are getting better at co-ordinating efforts to counterbalance Chinese economic and military

heft. The G7's plan was launched two days before the 30 members of NATO agreed at a summit to include threats posed by China in a blueprint for its future strategy. The summit was also attended for the first time by the leaders of Japan, South Korea, Australia and New Zealand. A few days earlier, America and four of its closest allies launched yet another initiative, the Partners in the Blue Pacific pact, aimed at offsetting Chinese influence in the Pacific islands.

In public, China has been dismissive of such efforts. "What the international community wants to see is real money and projects that actually benefit the people," said Zhao Lijian, a spokesman, after the PGII was launched. Privately, though, some Chinese experts worry that such Western efforts are gaining pace just as China's image has been tarnished by its zero-covid strategy and support for Russia in Ukraine.

Yet there are reasons to be sceptical of the G7's plan, too. It is a repackaging of an idea called Build Back Better World that was launched at the group's summit last year. The rebranding was partly due to Mr Biden's failure to win congressional support for his domestic Build Back Better initiative, Western officials say. But they also concede that there was little progress in implementing the international plan.

The G7's plan has roots, too, in an even earlier initiative, the Blue Dot Network, which was started by America, Japan and Australia in 2019 but has made little headway, in part because of differences over climate change. There are also overlaps with the EU's Global Gateway scheme, launched in December to "mobilise" €300bn (\$340bn) in infrastructure investment by 2027, and Britain's Clean Green Initiative, unveiled a month earlier with a pledge of £3bn (\$4.1bn) for sustainable infrastructure in developing countries.

Western officials say these efforts are complementary. But some observers

see a lack of new money on offer. They worry that inflation and domestic politics will limit state funding, and the private sector will be wary of investing in unstable countries. “One has to wonder if this isn’t all just too little, too late,” said Matt Ferchen of the Leiden Asia Centre in the Netherlands.

In one indication of how the G7 will try to meet its \$600bn goal, the White House listed several ongoing projects that were retroactively included. China did the same when it launched the BRI. But the G7 will need to show more substantial results fast if it is to convince developing countries that it offers a better alternative to China’s new Silk Road, rather than a dead end.





打造阵营

七国集团终于提出了抗衡中国“一带一路”倡议的方案

就在中国开始缩减自己的计划之际

自中国发起“一带一路”倡议（一场耗资万亿美元的全球基础设施建设狂潮）以来的九年里，美国反制该计划的努力一再失败。奥巴马政府未能说服盟友抵制中国主导的亚洲基础设施投资银行。奥巴马兜售了一项自由贸易协定，即《跨太平洋伙伴关系协定》，但特朗普在入主白宫的第一周就把它废了。

由于一些国家难以偿还中国的贷款，特朗普政府将“一带一路”称为“债务陷阱外交”，获得了一些响应。但从2013年到2021年，该倡议仍然带来了约8900亿美元的投资和建设合同（许多由中国贷款资助），复旦大学的王珂礼（Christoph Nedopil Wang）表示。每当美国批评中国的“新丝绸之路”时，反击者就会说：“你拿什么来代替它？”

现在，就在中国开始缩减其计划之际，美国及其盟国似乎有了答案。6月26日，由富裕民主国家组成的七国集团（G7）公布了一项计划，在未来五年动员6000亿美元的私人和公共投资，用于中低收入国家的基础设施。它被称为“全球基础设施和投资伙伴关系”（PGII）。拜登总统表示美国将提供2000亿美元。

西方官员表示，该计划不会与专注于港口、铁路和其他“硬”基础设施的“一带一路”倡议直接竞争，而是将通过优先考虑气候和能源安全、数字连接、健康和妇女平等来发挥G7的优势。与中国的计划相比，它承诺在财务、环境和社会方面都是透明和可持续的。中国的项目主要涉及来自国有银行的贷款，PGII的目标则是利用有限的政府资源来促进更大规模的私人投资。“这不是援助或慈善，”拜登在计划启动时说，“这是一项将为每个人带来回报的投资。”

从表面上看，该计划对中国来说是个坏消息。“一带一路”已经面临阻力，

一方面是因为对商业上有问题的项目过度放贷，一方面是缘于新冠疫情的影响。曾经被誉为“一带一路”核心的巴基斯坦已走到违约的边缘。另一个接受中国贷款的大户斯里兰卡已在5月违约。“一带一路”也已变得太大，无法有效管理。这些问题加上国内经济放缓，促使计划规模缩减，并将资金转投规模较小、质量更高的项目，以及医疗保健等“软”基础设施。尽管“一带一路”倡议将继续（已写入宪法），但中国国家主席习近平现在正在推动一个新理念“全球发展倡议”，预计将更加关注可持续发展。

其结果是，中国的努力将越来越多地与G7直接竞争。一些中国专家警告说，这将使中国的战略目标复杂化。中国社科院的王永忠表示，西方国家着眼于具有比较优势的“软”基础设施，旨在促进本国在5G通信、区块链和清洁能源等领域的技术和服务出口。他在官方杂志《人民论坛》上写道，这将使他们“获得丰厚的地缘政治和经济回报”。

中国更广泛的担忧在于，美国及其盟国越来越善于协调努力，以制衡中国的经济和军事影响力。G7的计划启动两天后，北约30个成员国在峰会上同意将中国构成的威胁纳入其未来战略蓝图。日本、韩国、澳大利亚和新西兰的领导人首次出席了该峰会。几天前，美国及其四个最亲密的盟友发起了另一项倡议——“蓝太平洋伙伴协定”，旨在抵消中国在太平洋岛屿的影响力。

在公开场合，中国一直对此类努力不屑一顾。“国际社会希望看到的是真金白银和实实在在造福于民的项目。”发言人赵立坚在PGII启动后表示。不过，一些中国专家私底下担心，西方的这种努力正在加快步伐，而中国的形象却因其清零防疫政策和在俄乌战争中支持俄罗斯而受损。

然而，也有理由对G7的计划抱持怀疑。这个计划是对去年在该组织峰会上发起的名为“重建更好世界”的理念的重新包装。西方官员说，更名的部分原因是拜登未能赢得国会对其国内“重建美好未来”倡议的支持。但他们也承认，在实施该国际计划方面进展甚微。

G7的计划也根源于更早的“蓝点网络”倡议，该倡议由美国、日本和澳大利

亚于2019年发起，但无甚进展，部分原因是在气候变化方面的分歧。它与欧盟的“全球门户”计划也有重叠，该计划于去年12月启动，旨在到2027年“动员”3000亿欧元（3400亿美元）的基础设施投资；它也呼应英国的“清洁绿色倡议”，该计划于去年11月公布，承诺提供30亿英镑（41亿美元）用于发展中国家的可持续基础设施。

西方官员说，这些努力是相辅相成的。但一些观察家认为新资金来源不足。他们担心通货膨胀和国内政治将限制国家资金，而私营部门会对投资于不稳定的国家态度审慎。荷兰莱顿亚洲中心（Leiden Asia Centre）的Matt Ferchen（马特·菲尔肯）说：“人们免不了怀疑这是否太少、太晚了。”

为了展示G7将如何努力实现其6000亿美元的目标，白宫列出了几个正在进行中的项目，都是事后被算在计划之中的。中国在发起“一带一路”倡议时也是如此。但是，G7将需要能尽快展示更实质性的成果，以让发展中国家相信它提供了一条替代中国的新丝绸之路的更好路径，而不是死胡同。





Charlemagne

Travel chaos in Europe is a glimpse of a future with few spare workers

Employers are wondering where the staff went

Where did all the workers go? The question feels ubiquitous in Europe. From French cafés to Irish construction crews, Czech car factories and Italian farms, employers once assumed cheap staff could be summoned at will. Now the toilers seem to have simply vanished. Companies are grumbling, though rarely as loudly as Parisians waiting for an oblivious garçon to arrive with their drinks. In no sector is the lack of staff so glaring as in air travel. For weeks tourists at some of Europe's biggest airports have faced serpentine queues to catch their flights, assuming those flights have not been cancelled due to the shortage of hands. Going on a relaxing holiday has never seemed so stressful. In this economy, everybody in Europe can find work; as a result, Europe isn't working.

After two years of pandemic uncertainty, tourism is back (minus a few Asian visitors). For Europe, which attracts half the world's international travellers, that ought to be a boon. And yet the headlines are grim. Staff shortages at airports and airlines have prompted a surge in flight cancellations. In June, just as resorts and city centres ought to have been filling up, carriers in Britain, France, Germany, Italy and Spain cancelled nearly 8,000 flights, roughly three times the figure in 2019, according to Cirium, a consultancy. Each scrapped journey gives rise to a planeload of sob stories: Alicante stag parties postponed, Tuscan family getaways forsaken. American air travel has problems too, but nothing like the bedlam that has engulfed parts of Europe.

Those whose flights were not cancelled might wish they had been. Waiting times at Amsterdam's Schiphol airport ran to six hours on some days in late May, prompting KLM, the Dutch flag-carrier, to suspend bookings from its

main hub for four days. Given the chaos behind the scenes, checking in luggage has become an act of faith. At Paris's main airport, nearly half of all bags that were meant to follow their owners to their destinations on July 2nd went astray. Passengers have been warned by unions they may never be reunited with their swimming trunks. A member of the Cypriot parliament stuck at Frankfurt airport for two days decried the "third-world conditions" there in much the same tone some Germans use when they travel to the Mediterranean.

Some of the havoc is down to tourism rebounding unexpectedly fast. Deprived of holidays for years, vacationers are "revenge travelling", depleting what remains of their pandemic-era stimulus cheques. War on the fringes of the continent might have been expected to crimp demand. Instead it sent the euro tanking (to near parity with the American dollar), making Greek tavernas and Baltic beaches irresistible.

Airports should have been prepared. Forecasting the number of travellers on a given day is not unreasonably complicated, given that they have bought tickets well beforehand. But aviation bosses have complained for months of the difficulty of hiring staff. Ramping up operations takes time: airport security must be vetted and cabin crew trained (though you wouldn't know it at some airlines). Then came the strikes. Travel workers walking off the job in recent weeks included Scandinavian pilots, German security staff, French airport firemen, Dutch cleaners, Belgian cabin crew and Italian air-traffic controllers.

In part the strikes reflect workers demanding that pay keep up with high tourist loads and soaring inflation. But airports' difficulties are not merely the result of local labour troubles. Far beyond the tarmac, European workers currently have the upper hand. Unemployment in the euro area, at 6.6%, is at its lowest since the single currency was launched two decades ago. Some places have all but run out of workers: Germany's jobless rate is

just 2.8%. It would once have fixed a shortage of hands by importing willing throngs of Poles or Bulgarians. That no longer works: Poles and Bulgarians now find plenty of good jobs at home. Germany is issuing work permits to Turks to handle its luggage instead. Whatever reluctance it might have felt to let in more non-EU migrants has been set aside. Europe is now employing nearly everyone within its borders who is willing and able to work.

Some might suspect that generous welfare states are letting a lot of Europeans shirk. The talk last year was of a “Great Resignation” of the previously employed. Yet this does not seem to be the case. A higher percentage of 15- to 64-year-olds in the euro area have jobs than before lockdowns. The eu’s labour force, unlike Britain’s or America’s, is now bigger than before the pandemic, notes Jessica Hinds of Capital Economics. Many have better options than the jobs once reserved for them. “Everyone’s asking, where have they all gone?” pondered Tim Clark, the boss of Emirates airline, according to Bloomberg. “And the answer is always: Amazon.” It turns out that handling e-commerce packages for decent pay while listening to podcasts beats arriving at 5am to ask passengers whether they have packed any liquids in their carry-on. Or serving impatient Parisians their cocktails, for that matter.

| *Europe is healing*

Given its rigid labour rules and ho-hum growth in recent decades, Europe has not often had to face the problem of having too many jobs. It is a problem nonetheless. The dramas visible at airports are also unfolding in care homes, hotels and other places that need a lot of unskilled staff. They simply get less attention. Some workers may see salaries rise, though many firms that rely on cheap labour say they cannot afford to pay more. Meanwhile, the unions who typically bargain for permanent wage bumps may worry that doing so now might feed inflation.

Perhaps the labour market will regain some slack as Europe's economy slows down. Soaring energy prices have soured the mood in recent weeks, as has a resurgence of covid. That would hardly be good news, except for hard-up employers—and those looking to catch a bit of downtime on a far-flung beach. ■



查理曼

从欧洲的旅游混乱中瞥见一个工人紧缺的未来

雇主纳闷员工都去了哪里

工人们都去哪儿了？这个问题似乎正在整个欧洲上空回荡。从法国的咖啡馆，到爱尔兰的建筑工人、捷克的车厂，再到意大利的农场，雇主们曾经认为自己随时都可以招到廉价工人。但现在，这些劳动力仿佛人间蒸发了。企业牢骚不断，但餐馆里苦等待应生拿来饮料的巴黎人怨声更大。人手不足在航空部门最为凸显。最近几周，欧洲最大的几个机场里候机的游客们大排长龙——如果他们的航班没有因为缺人手而被取消的话。轻松度假这件事似乎从没有这么叫人心力交瘁过。在眼下的经济中，欧洲人人都能找到工作，但结果是整个欧洲不运作了。

在经历了两年由疫情引发的不确定性后，旅游业复苏了（少了一些亚洲游客）。对于吸引了全球一半国际旅客的欧洲来说，这本该是个福音。但新闻头条却愁云惨雾。机场和航空公司人员短缺导致航班取消激增。咨询公司Cirium的数据显示，在度假村和市中心本应人头攒动的6月，英国、法国、德国、意大利和西班牙的航空公司取消了近8000个航班，是2019年数字的约三倍。每一趟取消的飞行的背后是一整班旅客的失望遭遇：阿利坎特的单身派对推迟了，托斯卡纳的家庭度假泡汤了。美国的航空旅行也有问题，但和席卷欧洲部分地区的混乱场面没法比。

那些成功起飞了的人可能宁愿航班被取消了。5月下旬的某些日子里，阿姆斯特丹史基浦机场（Schiphol airport）的等候时间长达六小时，促使荷兰旗舰航空公司荷航（KLM）将这个主要枢纽的机票预订暂停了四天。在人们看不见的地方混乱之严重，已使得托运行李成了一种信仰行为。在巴黎戴高乐机场，本应在7月2日跟随主人前往目的地的所有行李中有近一半不知去向。工会已提醒乘客他们可能永远无法和自己的泳裤团聚。一名在法兰克福机场滞留了两天的塞浦路斯国会议员怒斥那里的“第三世界状况”，口气和一些德国人飞抵地中海时并无两样。

这种乱局一方面是缘于旅游业反弹之快出人意料。在连续几年被剥夺假期后，度假者正在“报复性出游”，要把在疫情期间收到的刺激支票里剩下的钱花完。人们原本预期欧洲大陆边缘的战火可能会抑制需求。结果它导致欧元贬值（到几乎与美元持平），让希腊的小酒馆和波罗的海的海滩变得难以抗拒。

机场本应准备好的。要预测某一天有多少乘客并不是多复杂的事，毕竟机票都是老早就买好的。但航空业老板们抱怨招人难已经有几个月了。扩大运营需要时间：必须审查机场安全，培训机组人员（虽然在某些航空公司这一点真是看不出来）。然后又发生了罢工。最近几周离职的旅游业人员包括斯堪的纳维亚国家的飞行员、德国的安检人员、法国的机场消防员、荷兰的保洁人员、比利时的机组人员，以及意大利的空管员。

罢工在一定程度上反映了工人要求工资跟上游客激增和通胀飙升。但机场的困境不仅仅源于本地劳工问题。在停机坪之外的广阔天地里，欧洲工人目前是占上风的。欧元区的失业率为6.6%，是自20年前推出单一货币以来的最低水平。有些地方几乎没有闲置劳动力了：德国的失业率仅为2.8%。它曾经可以通过输入大批愿意前来工作的波兰或保加利亚人来解决人手短缺的问题。现在不行了：波兰人和保加利亚人在自己国家找到了很多好工作。德国转而向土耳其人发放工作许可，让他们来处理行李。不管它过去对于让更多非欧盟移民入境有什么不情愿之处，都已经被暂搁一旁。欧洲现在雇用了欧洲大陆几乎所有愿意且能够工作的人。

有些人可能怀疑慷慨的福利国家使得很多欧洲人甘做咸鱼。去年人们大谈原本受雇人群的“大辞职潮”。然而现在看来情况并非如此。与封城前相比，欧元区15至64岁人群中有人工作的人占比上升了。凯投宏观（Capital Economics）的杰西卡·海因兹（Jessica Hinds）指出，与英国或美国不同，欧盟的劳动力队伍比疫情前更壮大。许多人现在拥有比为他们保留的职位更好的选择。在彭博社的报道中，阿联酋航空的老板蒂姆·克拉克（Tim Clark）沉思道，“每个人都在问，人都去哪儿了？而答案总是：亚马逊。”看起来，人们更愿意边听播客边处理网购包裹来挣一份还不错的薪水，而不是早上5点到机场询问乘客随身行李里是否有液体，或者为不

耐烦的巴黎人递上鸡尾酒。

| 欧洲在疗愈中

鉴于欧洲近几十年来严格的劳动力法规和平淡无奇的增长，它不常面对工作过多的问题。但目前这确实是个问题。在机场可见的戏剧性场面实际上也在养老院、酒店等需要大量低技能员工的地方上演，只不过并没有引起公众的注意。一些工人可能会获得加薪，虽然许多依赖廉价劳动力的公司表示付不起更高的工资了。与此同时，通常会争取永久加薪的工会可能会担心眼下这么做会助长通胀。

或许，随着欧洲经济放缓，其劳动力市场的压力会有所缓解。最近几周，能源价格大涨给人们的情绪泼了冷水，新冠病毒卷土重来也是如此。这不是什么好消息，除了对那些手头吃紧的雇主来说——还有那些想到遥远的海滩上放松一下的人。■



Tougher than tariffs

America rethinks its strategy for taking on China's economy

The focus is on whether Joe Biden will cut tariffs, but the real action is elsewhere

China is often said to be an area of rare consensus in American politics. Just about everyone agrees that something must be done to counter its rise. But this appearance of unity masks divisions and even confusion about what exactly needs to be done, most of all in the economic domain. Is the ultimate goal to open the Chinese market to American businesses, or to dissolve commercial bonds with China?

For Joe Biden's administration, these cross-currents have led to prolonged deliberations—so much so that some critics accuse it of paralysis. A seemingly endless debate about whether to remove tariffs on China is the latest example of indecision. Slowly, though, the shape of Mr Biden's approach to the Chinese economy is emerging. The coming weeks may determine whether it amounts to a resolute, coherent strategy or a mess of contradictions.

The narrative is clear enough. In a speech in May Antony Blinken, America's secretary of state, boiled down Mr Biden's China policy to three words: "invest, align, compete". That is, America should invest in its own strength; align more closely with allies; and confront China where necessary. Putting the spin to one side, these are in fact good categories for understanding how the Biden administration is trying to deal with China's economy.

Start with competition. This took centre-stage under Donald Trump, who dragged America away from a lingering desire to "engage" China towards a sharper rivalry with it. By the time he left office, America's average tariff on Chinese products had risen from roughly 3% to nearly 20%, according to

calculations by Chad Bown of the Peterson Institute for International Economics (see chart 1). The immediate question for Mr Biden is what to do about this inheritance.

With inflation running high, Mr Biden wants to lessen price pressures. Eliminating tariffs on China—which are, in effect, a tax on consumers—would in theory help. In practice it may make a very small contribution. One study from the Peterson Institute estimated that removing the tariffs would shave just 0.3 percentage points off the annual inflation rate, which is now running at more than 8%. On the one hand, every little counts. On the other, Mr Biden is loth to do something that would be portrayed by Republicans, and perhaps China itself, as a capitulation.

Even within his own administration, many view the tariffs as precious leverage. The most likely outcome will be minor tweaks. Mr Trump's earlier tariffs went after products such as semiconductors. But later levies hit items like shoes, hurting consumers more directly. Removing tariffs on some consumer products would therefore seem like an easy decision. Beyond that, opposition to cuts grows steeper. "For tariffs on high-tech products or industrial inputs, the Biden administration may want to increase these substantially at the same time that it eliminates others. It needs to determine which are working and which are not," says Clete Willems, a veteran of Mr Trump's trade team. Hawks welcome the fact that America imports less from China than it did at the start of the trade war (see chart 2).

The Biden administration has also debated whether to begin a new probe into China's economic behaviour. Mr Trump's big investigation, conducted under section 301 of American trade law (used to tackle problems not solvable within the WTO), was focused on China's "forced technology transfers". Many in the Biden administration see that as a misdiagnosis.

The real issue is China's broader state capitalism.

A new 301 investigation could put China's industrial plans and subsidies at the forefront of America's economic grievances with it. Intellectually, that would be appealing. "The bigger challenge will be, is the administration ready to do what a 301 says? Is it ready to impose significant new penalties on China?" says Scott Kennedy of the Centre for Strategic and International Studies, a think-tank in Washington. The White House's delay in announcing a new 301 case, despite talk swirling around it for months, reveals its hesitancy.

Another plank in America's competition with China is the battery of economic sanctions rolled out against companies. Mr Trump's administration blazed the trail, placing Chinese industrial champions from Huawei, a telecoms giant, to DJI, a dronemaker, on the government's "entity list", thereby preventing American companies from selling them any items without permission. By the end of his term, though, his methods were increasingly chaotic, epitomised by his ill-fated demand that the Chinese owner of TikTok, a wildly popular app, spin off its American operations.

Mr Biden's team has worked to place sanctions on a sounder legal footing, while also making them more targeted. Most of Mr Trump's corporate blacklistings are still in place. Mr Biden has added to them, including barring American investments in a range of Chinese surveillance-tech companies. It is also considering new rules to block foreign rivals' access to Americans' personal data, which may yet ensnare TikTok. Taken together, the Biden approach looks less like a retreat from Mr Trump's brawl with China and more like a professionalisation of it.

The second part of Mr Biden's strategy—alignment with allies—sets him much further apart from his predecessor. Whereas Mr Trump revelled in scorning America's staunchest friends, Mr Biden has steadfastly repaired

relations. The cornerstone of his approach to Asia was unveiled in May with the launch of the Indo-Pacific Economic Framework (IPEF), tying together countries that represent 40% of global GDP. India, Japan and Vietnam are part of it and, most crucially, China is not. Another fruit of Mr Biden's efforts was a joint statement at the end of the G7 summit on June 28th pledging to "reduce strategic dependencies" on China.

There are doubts that these fine words will add up to much concrete action. The messages shared by several Asian diplomats about the IPEF are remarkably similar: it is good to have America back at the table, but the only dish on offer is thin gruel. The IPEF will include discussions about everything from decarbonisation to data sharing, but there will be nothing on tariffs, a mainstay of traditional trade talks. The Biden administration disputes this characterisation. One senior official points to the IPEF's focus on supply chains, arguing that it will be meaty. With talks starting later this month, the official believes that a deal to accelerate port-clearance times could be reached within as little as a year.

Even if that comes to fruition, there is frustration among many in America and abroad that Mr Biden will not do more on trade. A stubborn bipartisan group of politicians in Washington is still agitating for America to re-enter the Trans-Pacific Partnership, a regional trade deal from which Mr Trump withdrew. Allies such as Japan would love that. They believe forging new supply chains is essential to lessening reliance on China. For the Biden administration, though, the idea is a non-starter; it is fearful of alienating union supporters and angering a trade-wary public. The unsatisfactory conclusion is that Mr Biden's desire to align with allies in its China strategy can only go so far.

That speaks to the final element of Mr Biden's approach: investing at home. This is the area where rhetoric and action are furthest apart. After all, Mr Biden's signature spending plan, his "Build Back Better" social-and-climate

package, has not yet made it through Congress. It is now crunch time for an initiative that was conceived as a response to China. The Senate and House have passed two alternative bills with the same centrepiece: a \$52bn plan for bolstering America's capacity to produce semiconductors. The Senate's is more modest and has received bipartisan support. The House's, almost exclusively backed by Democrats, contains a hotch-potch of measures—including even funding to save coral reefs.

People familiar with talks to bridge the differences say there has been recent progress, bringing the unified bill closer to the Senate's version. One aspect of the House's may, in reduced form, survive: the creation of a mechanism that, for the first time, would require American companies to notify the government of overseas spending, raising the possibility that the White House could block some investments in China. For the bill to pass before mid-term elections in November, agreement will probably have to be hammered out before Congress breaks for recess for August.

Even without that bill, the Biden administration has tried to set the tone for an investment push at home. Mr Trump cajoled and threatened companies to set up factories in America, making limited headway. Mr Biden's big initiative, grabbing fewer headlines, has been a sprawling review of supply chains. In February the government published six separate reports, covering semiconductors, batteries and more. This hardly equates to industrial policy on a Chinese scale. But the aim is to channel financing and incentives to strengthen America's manufacturing base.

The Biden plan may be pushing at an open door. Since the start of his administration companies have announced more than \$75bn of investments in semiconductor production and research in America. That is in part a response to Mr Biden's actions, but also a recognition of the fragility of global supply chains. Indeed, perhaps the most useful policy in weaning companies off the Chinese market is Xi Jinping's foolhardy pursuit

of “zero covid”, which has almost walled off the country.

If Mr Biden does succeed in boosting domestic manufacturing, that victory could well come at the cost of higher prices for consumers, reduced efficiency and, ultimately, lower economic growth. True, he is rebuilding frayed relationships with allies. But in other respects, his economic strategy for dealing with China looks a lot like a refinement of the bare-knuckle competition started by Mr Trump. ■



比关税更重手

美国反思对抗中国经济的策略

拜登会否削减关税成为焦点，但真正的行动落在别处

人们常说对华政策是美国政治中少有的共识领域。几乎人人都认为必须做点什么来对付中国崛起。但这种一致的表象掩盖了关于具体该怎么做的分歧乃至困惑，在经济领域尤甚。行动的最终目标是要促使中国向美国企业开放市场吗？还是要解除和中国的商业纽带？

这些分歧令拜登政府迟迟难以决断，以至于有批评人士指责其陷于瘫痪。对是否取消对华关税的争论似乎无休无止，是这种优柔寡断的最新例证。但渐渐地，拜登应对中国经济的思路正逐步显现。它会是一套坚定的、协调一致的战略，还是相互矛盾的一团乱麻，未来几周也许能见分晓。

公开的论调已足够清晰。在5月的一次演讲中，美国国务卿布林肯把拜登的对华政策归纳为三个词：“投资、结盟、竞争。”具体的意思是，美国应投资于加强自身实力，与盟友更紧密地联结，在必要时对抗中国。抛开这种外交辞令不谈，透过这一总结，我们可以很好地理解拜登政府试图应对中国经济的思路。

先看竞争。这在特朗普任期成为中心议题，原本仍想着“拉拢”中国的美国在这一时期大掉头，与中国展开更尖锐的对抗。据彼得森国际经济研究所（Peterson Institute for International Economics）的查德·鲍恩（Chad Bown）计算，到特朗普卸任时，美国对中国产品征收的平均关税已从约3%上升到近20%（见图表1）。该如何处理这一遗留政策是摆在拜登眼前的问题。

面对通胀居高不下，拜登希望减轻价格压力。取消对中国的关税（实际上是对消费者征税）理论上会有帮助。但实际作用可能不大。彼得森研究所的一项研究估计，取消对华关税只会让年通胀下降0.3个百分点，而目前美国通胀超过8%。一方面，任何一点帮助都是有用的。但另一方面，拜

登又不愿自己的行动被共和党人——可能还有中国——说成是妥协。

连拜登政府内也有许多人视关税为宝贵的筹码。最可能的结果会是小幅调整。特朗普早期加征的关税针对的是半导体等产品。但后来连鞋履等商品也遭到征税，更直接地损害了消费者的利益。因此，似乎不难下决心取消对部分消费产品的关税。但对于其他产品，反对削减关税的立场变得越发强硬。“拜登政府可能想在取消部分产品关税的同时，大幅提高对高科技产品或工业原料的关税，它需要决定哪些可行，哪些不可行。”特朗普政府前贸易官员克莱特·威廉姆斯（Clete Willems）说。相比中美贸易战之初，美国从中国进口的货物减少了（见图表2），鹰派人士对此喜闻乐见。

拜登政府也已在辩论是否要对中国的经济行为启动新的调查。特朗普根据美国贸易法第301条（用以处理世贸组织无法解决的问题）进行的大规模调查主要针对中国“强制技术转让”。拜登政府的众多官员认为这属于错判。真正的问题在于中国更广泛的国家资本主义。

新一轮301调查可能把美国在经济上对中国的不满聚焦于中国的产业计划和补贴。从做研究的层面来说，这很有吸引力。“更大的挑战是，拜登政府准备好按301调查的结果行事吗？愿意对中国施以新的严惩吗？”华盛顿智库组织战略与国际研究中心（Centre for Strategic and International Studies）的斯科特·肯尼迪（Scott Kennedy）说。尽管白宫几个月来都在谈论启动新的301调查，却迟迟没有行动，足见其犹豫不决。

美国与中国竞争的另一政策核心是对企业实施一系列经济制裁。特朗普政府开创先河，把电信巨头华为、无人机制造商大疆创新等中国产业龙头企业列入美政府的“实体清单”，阻止美国公司在未经许可的情况下向这些企业出售任何商品。但到特朗普任期末期，他的举措越发混乱，最显著的例子是要求热门应用TikTok的中国母公司分拆在美国的业务，最终告吹。

拜登团队力图让制裁措施有更坚实的法律依据且更有针对性。特朗普时期的企业黑名单大体保留了下来。拜登继续扩大名单，包括禁止美国公司投

资一批中国的监控技术公司。拜登团队还在考虑制定新规则，阻止外国竞争对手获取美国人的个人数据——TikTok可能又要被牵扯其中。综合来看，拜登的做法不像是要退出特朗普与中国的喧闹争斗，而更像是把这种打法专业化。

拜登对华战略的第二部分是联合盟友，这与前任总统的做法迥异。特朗普喜欢嘲讽美国最忠实的盟友，拜登则一直坚持修补这些关系。随着《印太经济框架》（Indo-Pacific Economic Framework, 以下简称IPEF）在5月推出，GDP总和占全球40%的国家结盟，拜登奠定了自己亚洲策略的基石。IPEF成员国包括印度、日本和越南，而最关键的是中国不在其中。拜登努力的另一个成果是在6月28日的七国集团峰会闭幕时发表的联合声明，其中誓言“减少战略依赖”中国。

有人质疑这些堂皇的辞令有多少能付诸实施。几位亚洲的外交官就IPEF发表的言论非常相似：美国重回饭桌是件好事，但端上来的菜肴只有稀粥。IPEF将协商从脱碳到数据共享的各种议题，但作为传统贸易谈判主干的关税问题却不在内。拜登政府反驳这样的说法。一名高官指出IPEF的重点是供应链，称那会是一道大菜。他认为，随着本月稍后IPEF谈判开启，最快可在一年内达成一项加快港口清关时间的协议。

即便这能实现，美国国内外还是有很多人认为拜登不会在贸易方面做更多感到失望。华盛顿一群顽固的两党政客仍在鼓动美国重新加入《跨太平洋伙伴关系协定》（Trans-Pacific Partnership, 以下简称TPP），之前特朗普退出了这一区域贸易协定。日本等盟友希望美国重回TPP。这些国家认为，要减少对中国的依赖，打造新供应链至关重要。但对拜登政府来说重回TPP是不可能的——它害怕得罪工会支持者，激怒对贸易心存疑虑的大众。令人失望的结论是，在拜登的中国战略中，团结盟友的决心只能走到这个程度。

这也指向了拜登战略的最后一个要素：在美国国内投资。这是言与行差距最大的环节。毕竟拜登的招牌支出计划——注重社会和气候的《重建更好未来》法案（Build Back Better）——尚未获国会通过。这项为反击中国而

打造的计划现在来到了关键时刻。参众两院已分别通过了两个替代版本，其核心内容相同——一个用于提升美国半导体产能的价值520亿美元的计划。参议院的版本更为节制，得到了两党支持。众议院的版本几乎只有民主党人支持，其中混杂了各类举措，甚至包括拨款拯救珊瑚礁。

知情人士表示，为弥合分歧而展开的磋商最近取得了进展，达成一致的法案更接近参议院的版本。众议院版本中的一项内容经减缩后可能得以保留：首次建立机制要求美国公司向政府报备海外支出，增加了白宫阻止某些对华投资的可能性。为在11月中期选举前通过法案，可能需要在国会8月休会前取得共识。

即使没有该法案，拜登政府也已努力定下基调要在美国国内推动投资。特朗普恩威并施促使企业在美国设厂，但成效有限。拜登的大动作（媒体关注较少）是全面检讨供应链的现状。2月，拜登政府分别发布了六份报告，涵盖半导体、电池等领域。这些算不上是中国那样的产业政策，但目的是引导融资和激励措施以加强美国制造业的根基。

拜登的计划也许是在顺风行舟。自他上台以来，企业界已承诺在美国国内的半导体生产和研究方面投资超过750亿美元。这在一定程度上是对拜登举措的回应，但也是因为意识到了全球供应链的脆弱。事实上，要让西方企业摆脱对中国市场的依赖，最有用的政策也许是习近平对“新冠清零”的执着追求，它几乎已使中国与世隔绝。

假如拜登真能成功提振美国国内制造业，这一胜利很可能是以消费者价格上涨、效率下降以及最终经济增速减慢为代价的。没错，他是在重建与盟友破损的关系。但在其他方面，他的对华经济战略貌似只是特朗普挑起的那种粗暴争斗的改良版。■



Neuroscience

How neurons really work is being elucidated

That will help both medicine and the search for better artificial intelligence

A neuron is a thing of beauty. Ever since Santiago Ramón y Cajal stained them with silver nitrate to make them visible under the microscopes of the 1880s (see drawing above), their ramifications have fired the scientific imagination. Ramón y Cajal called them the butterflies of the soul.

Those ramifications—dendrites by the dozen to collect incoming signals, called action potentials, from other neurons, and a single axon to pass on the summed wisdom of those signals in the form of another action potential, turn neurons into parts of far bigger structures known as neural networks. Engineers now use simulacra of these to create what they are pleased to call artificial intelligence, though it is a pale shade of the real thing.

How neurons actually work their magic is only now being disentangled. One conclusion is that each is, in its own right, as powerful an information processor as a fair-sized artificial neural network. That has implications not only for learning how brains work—and how they go wrong—but also for designing artificial versions that more closely resemble the natural sort.

The first widely adopted neuron model, proposed in its existing form in 1957 by Frank Rosenblatt, an American psychologist (who drew, in turn, on Alan Turing, a British computing pioneer), was the perceptron. This is a mathematical function that receives sets of binary digits (zeros and ones) as inputs. It multiplies these by numerical “weights” and then adds the products together. If the result exceeds a preordained value, the perceptron spits out a “one”. If not, it spits out a “zero”.

| *Layer cake*

To make artificial neural networks, perceptrons are encoded as software. They are organised, logically speaking, into interconnected layers and the result is trained to solve problems via feedback and feedforward loops between the layers. These loops alter the values of the weights, and thus the behaviour of the network. The more layers, the “deeper” the network. Deep neural networks now underpin everything from Google Translate to Apple’s Siri.

All this imitates how action potentials arriving at the synaptic junctions between axons and dendrites, via which neurons communicate, were thought to trigger signals that then combined with each other to trigger (or not) new action potentials in the receiving cell’s axon. It is thus tempting to see neurons as physical perceptrons, with the difference from the computer versions that their signals are carried by sodium, potassium and calcium ions crossing cell membranes, rather than by a flow of electrons. And for decades that was just how many neuroscientists did see them.

In the early 2000s, though, Panayiota Poirazi of the Institute of Molecular Biology and Biotechnology in Heraklion, Greece, began looking at the matter differently. She imagined neurons themselves as perceptron networks. In 2003 she argued that a simple two-layer network might be enough to model them. Recent work has upped the ante. In 2021 David Beniaguev of the Hebrew University of Jerusalem concluded that, for human cortical neurons at least, five (and sometimes as many as eight) layers are needed, each with up to 256 perceptrons.

This means lots of computing must be going on inside individual neurons. And it is. Dendrites are now known to generate their own, tiny action potentials, called dendritic spikes. These come in several varieties: calcium spikes (long and slow); sodium spikes (short and fast); and NMDA spikes (triggered by a chemical called N-methyl-D-aspartate). Together, they let

dendrites perform 15 of the 16 basic operations of Boolean algebra, a branch of mathematics that is the basis of digital computing. Those operations compare two input values and spit out a third as a result. Some, such as and, or, not and nor, are self-explanatory. Others, such as nand, xnor and xor, less so.

xor, in particular, is notorious. It gives a non-zero output only when its inputs are dissimilar. In 1969 two eminent computer scientists, Marvin Minsky and Seymour Papert, proved that xor cannot be performed by a single perceptron—one of only two Boolean operation for which that is the case. This result stalled artificial-intelligence research for a decade, the first “AI Winter”, as it is retrospectively known.

That was thought true of dendrites, too. But in 2020 work by Albert Gidon of Humboldt University, in Berlin, in which Dr Poirazi was also involved, found a new class of calcium-based spike which permits xor. That a single dendrite can thus outperform a perceptron suggests an entire layer of complex computation is going on out of sight of conventional models of neurons. That might help explain the remarkable performance of brains and the failure of artificial intelligence to reproduce it.

Axons, too, have been reassessed. The action potentials they carry had once been seen by many as analogous to the all-or-nothingness of a binary digit. Look closely, though, and action potentials vary in both height and width. That matters.

In 2016 a group from the Max Planck Institute for Neuroscience, in Florida (one of the organisation’s few campuses outside its German homeland), showed that neurons in the central nervous system actively adjust the breadth of their action potentials. The following year a team from Dartmouth College in New Hampshire discovered that those in the cortex actively adjust their heights as well.

Even the lengths of the intervals between action potentials matter. In May 2021 Salman Qasim of Columbia University reported that neurons in the hippocampus, a part of the brain involved in memory formation, modulate the timing of their firing to encode information about the body's navigation through space. And in August of that year Leila Reddy and Matthew Self of the University of Toulouse, in France, reported that neurons also do this to encode the order of events in memories.

All this has clinical implications. In particular, there is growing evidence that atypical dendrite development in childhood and early adulthood is linked to autism, schizophrenia and epilepsy. Deteriorating axonal function, meanwhile, is similarly associated with psychosis in multiple sclerosis, schizophrenia and bipolar disorder. These discoveries inform the development of new medicines. For example, ketamine, which triggers long-lasting structural change in dendrites, is receiving attention as a treatment for depression.

| *The art of forgetting*

The sophistication of the neuron and its constituent parts has also caught the attention of computer scientists. In the early 2010s deep neural networks drove such dramatic improvements in the abilities of artificial intelligence that there was genuine concern people would soon have to wrestle with machines cleverer than they were. Then, suddenly, progress stalled.

Deep neural networks have hit three obstacles. First, computer scientists found that once a network has learnt a task, it struggles to transfer those skills to a new one, however similar, without extensive retraining. Second, when such a network is retrained, it tends to forget how to perform the original task—an effect called catastrophic forgetting. Third, to train a large network requires immense volumes of data, access to supercomputers, and the megawatts of electricity needed to run those supercomputers for days

(or even weeks) at a time.

The brain struggles with none of this. It effortlessly transfers knowledge between domains, has no trouble integrating old and new skills, and is remarkably efficient—running on watts, not megawatts. The sophistication of neurons may make the difference. In studies published last year and this, a team from Numenta, a Californian research company, designed artificial neurons, with dendrite-like subcomponents, that are immune to catastrophic forgetting. A network of these trained on 100 tasks in sequence retained the ability to perform all with reasonable accuracy. The same network also outperform networks of perceptrons at learning many tasks simultaneously.

Several studies show that sophisticated artificial neurons can approximate complicated functions—xor, for example—with greater accuracy and less energy than perceptrons do. Connected into networks, such devices learn faster and at a lower computing cost than perceptrons. The question of how brains apply knowledge from one domain to others remains a mystery, but it would not be a surprise if the complexity of neurons explains that, too.

The lesson, then, is familiar: nature got there first. Necessity may be the mother of invention, but natural selection is the mother of inventors. In both neuroscience and artificial intelligence the next decade promises to be wild. Over a century after he described them, Ramón y Cajal's butterflies are taking flight. ■



神经科学

澄清神经元的运作机制

这将助力医学发展和人工智能探索

神经元是优美之物。自1880年代圣地亚哥·拉蒙-卡哈尔（Santiago Ramón y Cajal）用硝酸银染色让它们在显微镜下露出真容之后（见上图），神经元的藤蔓状分支就触发了科学想象。拉蒙-卡哈尔称之为灵魂的蝴蝶。

这些分支包括数十个树突和一个轴突，树突收集其他神经元传入的信号（称为动作电位），然后通过轴突将这些信号的集合含义以另一个动作电位的形式传递下去。它们使各个神经元组合成为一个大得多的结构——称为神经网络。工程师现在模仿这种结构，创造出他们得意地称为人工智能的东西，不过它在真正的智能面前黯然失色。

神经元究竟是如何发挥其神奇作用的——这个谜团现在才徐徐解开。一个结论是，每一个神经元本身都是一个强大的信息处理器，如同一个相当规模的人工神经网络。这不仅有助于我们了解大脑如何工作——以及如何犯错，也有助于设计出更接近自然脑神经的人工神经网络。

1957年，美国心理学家弗兰克·罗森布拉特（Frank Rosenblatt）借鉴英国计算机先驱阿兰·图灵（Alan Turing）的理论，提出了第一个被广泛采用的神经元模型——感知机。它一直被沿用至今。这是一个数学函数，接收二进制的（0和1）数字集作为输入。它将这些数字乘以“权重”数值，然后将乘积相加。如果结果超过预先设定的值，感知机就会输出“1”。否则，就会输出“0”。

| 千层糕

为制作人工神经网络，感知机如今被编写成为软件。从逻辑上讲，它们组成相互连接的多个层，接受训练通过层与层之间的反馈和前馈循环来解决问题。这些循环回路会改变权重值，从而改变网络的行为。层次越多，网络就越“深”。现在，从谷歌翻译到苹果Siri的各种产品都由深度神经网络

支撑。

所有这些都是模拟按我们所认为的神经元运作方式：神经元通过轴突和树突之间的突触连接来彼此沟通，动作电位到达突触连接处后会触发信号，然后这些信号相互结合，在接收细胞的轴突触发（或不触发）新的动作电位。因此，人们难免将神经元看作实体感知机。与电脑感知机不同的是，它由穿过细胞膜的钠、钾和钙离子携带信号，而非电子流。几十年来，许多神经科学家确实就是这样认为的。

然而在21世纪初，希腊伊拉克利翁分子生物学和生物技术研究所（Institute of Molecular Biology and Biotechnology）的帕纳约塔·波拉齐（Panayiota Poirazi）开始以不同的方式看待这个问题。她把神经元本身看作感知机网络。2003年，她提出一个简单的两层网络可能就足以模拟神经元。最近的研究成果提高了标准。2021年，耶路撒冷希伯来大学（Hebrew University）的大卫·贝尼亚格夫（David Beniaguev）认为，至少对于人类皮层神经元而言，需要五层（有时甚至需要八层）网络，每层有多达256个感知机。

这意味着单个神经元内肯定进行着大量的计算。事实确实如此。现在已经知道树突会自己产生微小的动作电位，称为树突峰电位。它们有几种形式：钙峰（长而慢）；钠峰（短而快）；还有NMDA峰（由一种叫做n-甲基-d-天冬氨酸的化学物质触发）。通过它们的组合，树突可以完成16种布尔代数基本运算中的15种（布尔代数是数学的一个分支，也是数字计算的基础）。这些运算将两个输入值加以比较，然后输出第三个值。有些运算一目了然，例如and（与），or（或），not（非）和nor（或非）。其他一些就没那么简单，例如nand（与非），xnor（同或）和xor（异或）。

xor尤其难懂。它只有在输入值不同的情况下才会给出非零的输出。1969年，两位杰出的计算机科学家马文·明斯基（Marvin Minsky）和西摩·派珀特（Seymour Papert）证明了单单一个感知机无法完成xor运算——所有布尔运算中只有两种是这样。这让人工智能研究停滞了十年，也就是后来人们回顾时所说的第一个“AI冬天”。

人们过去认为树突也是如此。但在2020年，柏林洪堡大学（Humboldt University）的艾伯特·吉东（Albert Gidon）在研究中（波拉齐也有参与）发现了一种新型的钙峰，它可以完成xor运算。这样一来，单个树突的表现就能超越感知机，这表明传统的神经元模型遗漏了实际上发生着的整整另一个层次的复杂运算。这可能有助于解释大脑为何如此超凡卓越，以及人工智能为何难以复制它。

轴突的作用也被重新评估。许多人曾认为它们携带的动作电位类似于二进制数字的全有或全无。但仔细研究发现，动作电位在高度和宽度上都有所不同。这一点很重要。

2016年，位于佛罗里达州的马克斯·普朗克神经科学研究所（Max Planck Institute for Neuroscience，该所在德国本土之外的少数几个机构之一）的一个研究团队发现，中枢神经系统的神经元会主动调整其动作电位的宽度。次年，来自新罕布什尔州达特茅斯学院的一个团队发现，大脑皮层的神经元也会主动调整其电位高度。

甚至动作电位之间的间隔长度也有讲究。2021年5月，哥伦比亚大学的萨尔曼·卡西姆（Salman Qasim）称，海马体（大脑中与记忆形成有关的一个部分）的神经元会调节它们发出电位的时间，以编码身体的空间移动信息。同年8月，法国图卢兹大学的莱拉·雷迪（Leila Reddy）和马修·赛尔夫（Matthew Self）发现，神经元也通过这种方式来编码记忆中事件的顺序。

所有这些都具有临床意义。特别是有越来越多的证据表明儿童和成年早期的非典型树突发育与自闭症、精神分裂症和癫痫有关。同时，轴突功能退化与多发性硬化症伴随精神疾病、精神分裂症和躁郁症也有类似的关联。这些发现为新药研发提供了依据。例如，可以令树突结构发生长久变化的氯胺酮正受到关注，有望成为一种治疗抑郁症的药物。

| 遗忘的艺术

神经元及其组成部分的精巧复杂也引起了计算机科学家的注意。2010年代

初，深度神经网络推动了人工智能能力的大幅提升，以至于人们真的开始担心人类很快就不得不和更聪明的机器角力。然后，进展突然陷入了停滞。

深度神经网络碰到了三个障碍。首先，计算机科学家发现，一个网络学会一项任务之后，它很难将这些技能运用到一个新任务上，无论两者多么近似，仍然需要再次大量训练。其次，这样的网络经过重新训练后，往往会忘记如何执行先前的任务——这种效应被称为“灾难性遗忘”。第三，训练一个大型网络需要海量数据、超级计算机，以及这些超级计算机每次运行数天（甚至数周）所消耗的兆瓦级电力。

大脑不存在这些问题。它可以毫不费力跨领域转移运用知识，轻而易举地融合新旧技能，而且效率极高——只耗费瓦特级的能量，而非兆瓦级。神经元的精巧复杂可能是造成这种差异的原因。在去年和今年发表的研究中，加州研究公司Numenta的一个团队设计了具有树突状子组件的人造神经元，可以避免灾难性遗忘。一个由这些神经元组成的网络依次就100项任务进行训练后，留存了以不错的准确性执行所有任务的能力。这个网络在同时学习多项任务上的表现也优于感知机网络。

一些研究表明，复杂的人工神经元能以比感知机更精确、耗能更少的方式模拟复杂的函数，如xor。连接成网络后，这些设备的学习速度比感知机更快，运算成本也更低。大脑如何将一个领域的知识应用到其他领域仍然是一个谜，但如果最终也是因为神经元的复杂性，那也不会叫人意外。

因此我们可以得出一个熟悉的启示：大自然捷足先登。需要或许是发明之母，但自然选择是发明家之母。未来十年，神经科学和人工智能领域都将有惊人的发展。在他描述神经元一个多世纪后，拉蒙-卡哈尔的蝴蝶正在翩翩飞升。■



Free exchange

The case for strong and silent central banks

The second in our series on the central-bank pivot

Late on June 13th, a curious article appeared in the Wall Street Journal. It said that the Federal Reserve was “likely to consider” raising interest rates by 0.75 percentage points at its meeting on June 15th. The article was unusually silent about its sources. And it proved uncannily prescient. Two days later the Fed did indeed raise interest rates by that amount, its biggest increase in 28 years. Many investors believe the central bank had used the press to warn financial markets about what it would do in advance (albeit not very far in advance). That would make the Journal story an unconventional example of “forward guidance”.

Central banks often telegraph what they might do before they do it. This kind of forward guidance is as old as central banking itself, according to Willem Buiter, a former rate-setter at the Bank of England. It is certainly as old as inflation targeting. The Reserve Bank of New Zealand (which was the first to adopt a formal inflation target in 1990) quickly learned that it could move markets with its utterances (what it called “open-mouth operations”). It now publicly forecasts its own decisions. If you want to know where it thinks its policy interest rate will be in the future, you do not have to look out for mysteriously sourced stories in the press. You can just download the central bank’s spreadsheet.

This kind of guidance is intended as no more than a prediction, based on the central bank’s fallible forecasts of the economy. It is sometimes called “Delphic” guidance, after the oracle of Delphi in ancient Greece. If the economy defies the forecast, as it usually does, the central bank may well defy its prophecy of its own behaviour. In a paper published in 2012, Jeffrey Campbell, then of the Chicago Fed, and his co-authors distinguished

Delphic forward guidance from another kind, “Odyssean”. Odyssean guidance is more than just a prediction. It includes a promise or commitment of some kind. Central bankers use it to tie their own hands, like Odysseus lashing himself to the mast of his ship.

Why would they do that? The aim, as the paper put it, is to change public expectations about what central banks will do tomorrow, so as to improve the economy today. In a slump, a central bank might not have room to cut short-term interest rates by enough to revive the economy. (Rates cannot easily be cut below zero.) It might then promise to keep rates low for longer than it otherwise would, even after hearing the siren call of an economic recovery. If its promise is believed, expectations of inflation will rise. That will magically reduce the real cost of borrowing even when the central bank’s policy rate can fall no further.

Odyssean language crept into central-bank guidance after the financial crisis of 2007-09. In April 2009, for example, the Bank of Canada promised, with some qualifications, not to raise interest rates for 14 months. In 2016 the Bank of Japan said it would keep easing until inflation had durably overshoot its 2% target. Similar commitments were made in the pandemic. When a central bank is stuck close to the zero lower bound, it can at least say what it will do—or refrain from doing—when economic conditions warrant it moving again. Its words speak louder than inaction.

But when a central bank is not so constrained, the case for Odyssean forward guidance becomes less clear. If a central bank is free to act, why rely on words rather than deeds? In particular, why bother with forward guidance during a tightening cycle? There is, after all, no upper bound on interest rates. That question was recently posed on Twitter by Jason Furman, a former chairman of the White House’s Council of Economic Advisers.

If the central bank knows that interest rates should be higher in the future, there is nothing to stop it raising them now. Indeed, it could increase them up to the point where it is no longer sure if the next move should be up or down. In 2004 Ben Bernanke, a former chairman of the Fed, called this the “bang bang” approach. If a central bank were to adopt it, it would have little need to offer advance guidance about its future actions, because everything it is committed to do, it would have done already. In one go.

One reason why central banks nonetheless like to offer guidance is precisely because they dislike the bang-bang approach. They prefer to change interest rates in small increments. Forward guidance allows them to move gradually, while signalling that the first small step will not be the only one. But if investors heed the guidance, the future steps will be priced in to longer-term interest rates straight away. Thus gradual moves in the policy rate can be accompanied by big swings in broader financial conditions.

In principle, a central bank could abandon gradualism while still offering non-binding forecasts of what it might do in the future. But such Delphic utterances can be more trouble than they are worth. Financial markets often treat them as promises, not predictions. “People don’t hear the caveats that well,” says Mr Furman. Knowing this, central banks may feel unduly constrained by their past prophecies. That can make it harder than necessary to adjust when their predictions inevitably go awry. The Fed found itself in precisely such a predicament on June 10th, when surprisingly bad consumer-price inflation figures invalidated its recent prediction that it would raise interest rates by no more than half a percentage point at a time.

| *The strong, silent type of monetary policy*

Markets react badly when they think a central bank has broken a promise. That may add to volatility in itself. It may also erode the central bank’s

credibility, so that when it does need to make a commitment its words are no longer believed. Because promises are hard to keep, a central bank should make no more than necessary.

The Fed could not adopt a closed-mouth monetary policy overnight, Mr Furman points out. Preparing markets for such a shift would take time. But the Fed could start considering it for its next tightening cycle. Even better, he jokes, perhaps a pioneer like the Reserve Bank of New Zealand could try it for a year first. ■



自由交流

央行沉默是金的理由

央行策略转向系列第二篇

六月十三日晚，《华尔街日报》刊出了一篇奇怪的文章，说美联储“很可能会考虑”在6月15日的会议上加息0.75个百分点。文章对消息来源异乎寻常地守口如瓶。事实证明，它的先见之明令人不可思议。两天后，美联储确实加息了75个基点，为28年来最大的幅度。许多投资者认为，美联储利用了媒体来提前警告金融市场它将采取的行动（尽管没有提前很长时间）。这让《华尔街日报》的报道成了“前瞻性指引”的一个非常规范例。

对于自己下一步可能要做什么，央行常常会提前放风。根据前英国央行官员威廉姆·布特（Willem Buiter）的说法，这种前瞻性指引的历史与央行体系本身一样久。它至少和通胀目标制一样有年头。新西兰央行（在1990年第一个采用正式通胀目标）很快就发现它可以通过话语（所谓的“张口操作”）来影响市场。现在它会公开预测自己的决定。如果想知道它认为未来的政策利率水平会如何，不必在媒体上寻找来源秘而不宣的报道，直接去下载这家央行的电子表格就行了。

这种指引不过就是基于央行对经济的很可能出错的预判而发出的预测。这种指引有时被称为“德尔斐式”指引（借用了古希腊德尔斐神谕的典故）。如果经济没有如预判的那样运行——一般都会如此——央行就很可能不按它对自己的预测行事。在2012年发表的一篇论文中，时任芝加哥联储官员的杰弗里·坎贝尔（Jeffrey Campbell）与合著者将德尔斐式前瞻性指引与“奥德赛式”做了区分。奥德赛式指引不仅是预测，它包含了某种承诺或保证。央行官员用它来绑住自己的双手，就像奥德修斯把自己绑在船的桅杆上一样。

央行为什么要那样做？正如这篇论文所说，其目的是改变公众对央行未来行动的预期，从而改善当前的经济状况。在经济低迷期，央行可能没有足够的空间充分下调短期利率来重振经济。（利率不能轻易降到零以下。）

它可能转而承诺会在较通常情况下更长的时间里把利率保持在低位，即使在听到经济复苏如海妖塞壬般发出魅惑的召唤之后。如果公众相信央行的承诺，通胀预期就会上升。即使央行的政策利率没法再进一步下调，这也会神奇地发挥降低实际借贷成本的作用。

2007年至2009年金融危机之后，奥德赛式表述悄悄进入了央行的指引中。例如，2009年4月，加拿大央行承诺在满足一定条件的前提下，在14个月内不加息。2016年，日本央行表示将维持货币宽松政策，直到通胀持续超过2%的目标。疫情期间也有类似的承诺。当央行因利率接近于零下限而难以作为时，它至少可以说当经济条件发生变化需要央行再次采取措施时，它将做什么或不做什么。央行表态要好过不作为。

但当央行并未被如此束缚手脚时，提供奥德赛式前瞻性指引的理据就不那么清楚了。如果央行可以自由行动，为什么要光说不练呢？特别是为什么要在紧缩周期内给出前瞻性指引呢？毕竟利率是没有上限的。白宫经济顾问委员会前主席杰森·福尔曼（Jason Furman）最近就在推特上提出了这个问题。

如果央行知道未来利率应该更高，那么就没什么可以阻止它现在就加息。事实上，它可以一步到位，把利率上调到不确定下一步该加还是该降的水平。2004年，美联储前主席伯南克把这种做法称为“砰砰搞定”式。如果央行采用这一招，那它几乎不需要就其未来的举措提前提供指引，因为它承诺的每件事都已经做完了。是一气呵成。

央行仍然喜欢提供指引的一个原因正是因为它们不喜欢“砰砰搞定”法。它们更喜欢小幅渐进地调整利率。前瞻性指引让它们能够循序渐进，同时又向大家表明第一步的小幅调整只是个开头。但是，如果投资者听懂了指引，那么未来要实施的举措将立即反映在长期利率上。因此，政策利率的渐进调整可能伴随着广泛金融市场的大幅波动。

从原则上说，央行可以放弃渐进主义，同时仍对自己未来可能采取的行动提供不具约束力的预测。但这种德尔斐式的发声可能麻烦大于好处。金融

市场通常将它们视为承诺，而不是预测。“人们不会仔细去听附加说明。”福尔曼说。深知这一点的央行可能会感到过度受制于过去的预测。当它们的预测不可避免地出错时，这就可能会让政策调整变得难上加难。6月10日美联储就陷入了这样的困境中，那天意外糟糕的消费者价格通胀数据推翻了它前不久做出的一次加息不超过50个基点的预测。

| 沉默是金的货币政策

如果市场认为央行违背了承诺，它们会做出负面反应。这本身就可能会增加波动性，还可能削弱央行的信誉，等到它确实需要做出承诺时，市场却不再相信它的话了。信守承诺很难，所以央行不应做出超出必要的承诺。

福尔曼指出，美联储不可能在一夜之间采取“闭口不谈”的货币政策。让市场为这种转变做好准备需要时间。但美联储可以开始考虑在下一个紧缩周期采纳这样的政策。福尔曼开玩笑说，也许像新西兰央行这样的先驱者可以先试行一年，那就更好了。■



Bartleby

Beach reads for business folk

What to read when you are not working

Summer is in the air. People in the northern hemisphere are starting to discuss holiday plans and making some bold wardrobe choices. Recommendations for beach reads are coming out left, right and centre. The oddest of such lists are those aimed at the relaxed executive.

Each summer JPMorgan Chase's wealth managers release a reading list. Their recommendations for 2022 include a book by a bunch of McKinsey consultants on CEO excellence and a comprehensive guide to non-fungible tokens. You can almost smell the sun-tan lotion. This year's reading list is also available to explore in the metaverse, because nothing says the azure waters of the Mediterranean like choosing an avatar.

In its pick of summer business books, the Financial Times has chosen titles that range from hybrid work to the pitfalls of strategy. HR Exchange Network, a news site, encourages its readers to lounge on the beach with a copy of the "Essential HR Handbook"—and appears not to be joking. It is only a matter of time before The Economist does something similar.

People should read whatever they want. The books on the list may well be useful: no mosquito would survive contact with the "Essential HR Handbook". But anything that contains the words "blockchain" or "McKinsey" is missing the point. Plenty of people spend the majority of their waking hours either working or thinking about work. The idea of a summer read is that it should provide an escape from the office, not yet another way to think about it.

In an ideal world people would pack several P.G. Wodehouses and switch

off entirely. But publishers could also do their bit and release titles that really are meant to be beach reads on business. These books would be aimed at the off-duty person behind the Zoom screen. They would contain precisely no tips on productivity gains and extol inactivity over frenzy. Instead of showing you “how you too can model yourself on the very best”, as the book on successful chief executives allegedly will, summer titles should give you permission to fall asleep in a pool of your own dribble. Here, then, are a few suggestions to get the industry thinking.

In 2005 two inseat professors, W. Chan Kim and Renée Mauborgne, wrote a book called “Blue Ocean Strategy”, which divided marketplaces into uncontested areas (the “blue ocean”) and those infested by predatory competitors (the “red ocean”). But what if you don’t really fancy getting in the water at all? “Yellow Sand Strategy” makes the case that sometimes the best thing to do is remain entirely inactive and hope that nothing bad happens. (“Yellow Ocean Strategy” is a different book entirely, for executives who do things so incompetently that no one gives them any extra work.)

The United States Marine Corps has a practice of having senior officers serve up meals to junior members of the unit as a way of cementing bonds. That habit lay behind the title of a management bestseller published by Simon Sinek called “Leaders Eat Last”. On holiday, though, you don’t have to build morale or worry about your team. Read “Leaders Eat Three Club Sandwiches In a Row and Need to Have a Short Lie-Down”, and feel better about yourself.

In “The Innovator’s Dilemma” Clayton Christensen describes how leaders of established firms often fail to take advantage of new technologies and risk letting scrappy startups turn into formidable rivals as a result. But the summer break is no time to be thinking about disruption of any kind. Instead, turn your mind to more prosaic problems. “The Procrastinator’s

Dilemma” looks at the difficult choice people face between letting work pile up until it really has to be done or letting work pile up until it really, really has to be done.

The closer you look, the more you realise that underachievers and rank amateurs are badly served by business publishers. There is a market for laziness: the success of “The 4-Hour Work Week”, by Tim Ferriss, was no accident. With just a few tweaks here and there, many entries in the back catalogue of business bestsellers become ripe for the beach. From “Seven Habits of Highly Ineffective People” to “Start with Why Should I” and “What Colour is Your Sun Lounger?”, the possibilities are endless.

These are not the sort of titles anyone wants to be seen reading at work or posting about on LinkedIn. There are no bragging rights associated with them. But the beach is a place to unwind. If ever there is a time for reading lists to indulge the unmotivated and celebrate indolence, the summer is it. ■



巴托比

商务人士的海滩读物

不工作的时候读什么

空气中弥漫着夏日气息。北半球的人们开始讨论度假计划，也开始大胆挑选衣服。关于沙滩阅读的建议从四面八方涌来。其中最奇怪的书单是为放松下来的高管们准备的。

每年夏天，摩根大通的理财经理都会发布一份书单。他们2022年的推荐包括几个麦肯锡顾问撰写的关于CEO卓越特质的书，还有一本介绍非同质化代币（NFT）的全面指南。你差不多闻到防晒霜的气味了吧。今年的阅读清单还可以在元宇宙里探索，因为没有什么比选择一个化身更能感受地中海的湛蓝海水了。

《金融时报》今夏的商业书单涵盖混合式工作和战略的陷阱。新闻网站HR Exchange Network鼓励读者躺在沙滩上时捧起一本《人力资源宝典》（Essential HR Handbook）——而且听起来不像是在开玩笑。《经济学人》迟早也会这么干的。

大家应该读自己想读的东西。书单上的书很可能是有用的：抡起一本《人力资源宝典》拍过去，没有蚊子还能活下来。可凡是包含“区块链”或“麦肯锡”这类词的书都没抓住重点。很多人醒着的大部分时间里要么在工作，要么在想工作上的事。夏季阅读的要义是它能让人逃离办公室，而不是又多一种方式去思考工作。

在一个理想世界里，人们会带上几本P·G·沃德豪斯（P.G. Wodehouses）的书，完全隔绝工作。但出版社也可以尽一份力，出几本真正适合海滩阅读的商业书籍。这些书的目标读者是在Zoom屏幕之后卸下工作重担的人。书里不会有任何提高生产率的建议，会赞美躺平而不是打鸡血。它们不会论述“你如何也能向最优秀的人看齐”——据说那本关于成功CEO的书就会告诉你这个。夏日读物应该让你能在自己的一汪口水里

入梦。所以这里有一些建议，供出版商打开思路。

2005年，欧洲工商管理学院（INSEAD）的两位教授金伟灿和勒妮·莫博涅（Renée Mauborgne）写了一本《蓝海战略》（Blue Ocean Strategy），把市场划分为无竞争区域（“蓝海”）和遍布凶猛捕食的手的区域（“红海”）。但要是你根本不喜欢下水呢？根据“黄沙战略”，有时最好的做法就是什么也不做，祈祷不会有坏事发生。《黄海战略》（Yellow Ocean Strategy）是一本截然不同的书，写给那些成事不足、所以没人再给他们派更多任务的高管。

美国海军陆战队有个惯例，让高级军官给部队的初级士官准备饭菜以增进团结友爱。西蒙·斯涅克（Simon Sinek）撰写的管理学畅销书《团队领导最后吃饭》（Leaders Eat Last）说的就是这一套。不过，在假期里，你不用鼓舞士气，也无需担心你的团队。读读《团队领导连吃三个俱乐部三明治，得躺下歇会儿》（Leaders Eat Three Club Sandwiches In a Row and Need to Have a Short Lie-Down），你会自我感觉更好。

在《创新者的窘境》（The Innovator's Dilemma）一书中，克莱顿·克里斯滕森（Clayton Christensen）描述了老牌企业的领导者往往不能利用好新技术，因此可能会让初生之犊的创业公司变成自己强大的对手。但夏日假期不是思考任何一种颠覆的时候。把你的心思转向更寻常的麻烦吧。

《拖延者的窘境》（The Procrastinator's Dilemma）聚焦人们面对的一个艰难选择：是让工作堆到真的非做不可，还是堆到真的、真的非做不可。

越仔细观察，你就越会意识到，商业书籍出版商太过忽略了平庸无能之辈。懒惰是有市场的：蒂姆·费里斯（Tim Ferriss）写的《每周工作4小时》（The 4-Hour Work Week）能畅销并非偶然。只需在这里那里微调一下，许多经典商业畅销书就变成了海滩读物。从《低效能人士的七个习惯》到《从问“我为啥要呢”开始》，再到《你的太阳椅是什么颜色？》，可能性是无限的。

谁也不想工作时被人看见在读这样的书，也没人想把这样的书发到领英

上。这些书不能拿出来炫耀。但海滩是个放松的去处。如果说有那么一个时间点，书单可以纵容那些缺乏动力的人，并且庆祝慵懒怠惰，那就是夏天了。■



Bartleby

Why managers deserve more understanding

Don't overdo the sympathy, but the job is both necessary and demanding

Management is not a heroic calling. There is no Marvel character called “Captain Slide Deck”. Books and television shows set in offices are more likely to be comedic than admiring. When dramas depict the workplace, managers are almost always covering up some kind of chemical spill. Horrible bosses loom large in reality as well as in the popular imagination: if people leave their jobs, they often do so to escape bad managers. And any praise for decent bosses is tempered by the fact that they are usually paid more than the people they manage: they should be good.

A world without managers is a nice idea. But teams need leaders, irrespective of the quality of the people in charge. Someone has to take decisions, even if they are bad ones, to prevent the corporate machine gumming up with endless discussions. That is true even of flatter organisations. In a paper published in 2021, researchers described an experiment in which a number of different teams took part in an escape-room challenge. Some randomly selected groups were asked to choose a leader before the task began; the rest were not. The teams with leaders did much better: 63% of them completed the challenge within an hour, compared with only 44% of those in the control group.

The difference between good bosses and bad ones is striking. In one paper published in 2012, a trio of academics looked at the output of workers in a large services company who frequently switched between different supervisors. They found that the gap in output between the best and worst bosses was equivalent to adding an extra person to a nine-member team. Even the average boss enhanced their team's productivity by enough to justify their higher salary.

Managers are needed, but they do not have it easy. The job is structurally difficult. Most managers have to meet the expectations, sometimes unreasonable, of people below them and above them. The blurring of work-life boundaries as a result of the covid-19 pandemic seems to have made life tougher for them. Gallup, a pollster, found that in 2021 managers suffered higher levels of self-reported burnout than workers, and that the gap between these groups had widened considerably over the previous year.

They are subject to conflicting demands. They are meant to care about members of their teams and be ready to get rid of them. They are supposed to give people agency while making sure that things are done in the way the organisation wants. The concept of the “servant leader” is utter nonsense. (What next? The weepy psychopath? The serf dictator?) It is also a reflection of the different directions in which bosses are pulled.

Many of those in positions of power don't want to be managing at all. True, some of them have found their way into management because of thrusting ambition. But others have wound up there because it is the only route available to more pay and greater influence. Hence another screwed-up office character: the “reluctant leader”.

Managers are also handling the most baffling material on Earth: people. A study conducted by researchers in Germany found that handing out monetary bonuses for good attendance to apprentices in retail stores led to sharp rises in absenteeism (paying for behaviour that was previously considered normal seems to have made people feel licensed to bunk off). Another piece of research, by academics at IESE Business School and the Poole College of Management, found that empowering employees could lead to more unethical behaviour if workers felt under greater pressure to perform. The law of unintended consequences runs through the workplace.

Managers are allegedly human, too, and also susceptible to bias. Bosses who take steps to encourage employees to contribute their ideas are doing the right thing by their organisations and by their teams. But according to research by Hyunsun Park of the University of Maryland and her co-authors, the more they solicit input, the less likely they are to reward people for speaking up. Instead, they credit themselves for creating the right kind of environment. Laudable, no. Natural, yes.

It is true that managers do not save lives or nurture young minds. Even the best ones spout jargon and cause unholy amounts of irritation. The worst ones make life a misery. But the job that managers do is almost always necessary, often unpopular, sometimes done reluctantly and pretty difficult to boot. Every so often that is worth remembering. ■



巴托比

为什么应该给管理者多些理解

也用不着同情心泛滥。但这份工作很必要，也很难做

管理不是一份富有英雄色彩的职业。没有哪个漫威角色叫“幻灯片队长”。以办公室为背景的书和电视节目搞笑的居多，而不是赞美。当戏剧表现工作场所时，剧中的管理人员几乎总是在掩盖什么化学泄漏事件。除了在大众的想象中，可怕的老板在现实中也让人心生阴影：如果人们离职，通常是为了逃离差劲的管理者。就算老板真的不赖，夸赞到了嘴边也会咽回去：毕竟他们拿的薪水通常都比他们管理的人高，“好”不是应当应分的么？

一个没有管理者的世界是个不错的主意。但是团队总归需要领导，不论掌舵的人素质如何。总得有人拍板，即使是做出糟糕的决定，以免无休止的讨论使公司机器陷入停滞。即使是在更扁平的组织内也是如此。在2021年发表的一篇论文中，研究人员描述了一项实验，让一些不同的团队参加了一项密室逃生挑战。一些随机选择的小组被要求在任务开始前选择一个头领，其余小组不用。结果有领导者的团队表现要好得多，其中63%在一小时内完成了挑战，而对照组中只有44%。

好老板和坏老板差别惊人。在2012年发表的一篇论文中，三名学者研究了一家频繁切换不同主管的大型服务公司的员工产出。他们发现，在最好的老板和最差的老板治下，员工产出的差距相当于在一个九人团队中增加一个人。即使是水平居中的老板也提升了团队的生产率，程度配得上拿到的更高的薪水。

管理者不可或缺，但他们别想轻松度日。这项工作结构上就很困难。大多数主管必须满足下属和上司的期望，有时还是不合理的期望。新冠疫情让工作和生活的界限变得模糊，他们的日子似乎更不好过了。民意调查机构盖洛普发现，2021年，管理人员自陈的过劳水平比普通员工更高，而且这两个群体在这方面的差距在过去一年里大幅拉大。

他们受制于相互矛盾的要求。他们理当关心自己团队的成员，也要随时准备好开掉他们。他们应该赋予员工能动性，同时又要确保工作按照组织希望的方式开展。“仆人式领导”这个概念纯粹是胡扯。（接下来又是什么，多愁善感的精神病患？农奴独裁者？）它也反映出来自不同方向的力量在拉扯着老板们。

许多身居要位的人根本不想管理。的确，他们当中有些人是因为澎湃的雄心而打入管理层，但其他人往高处爬是因为这是获得更高报酬和更大影响力的唯一途径。于是，又一个心力交瘁的办公室角色出现了：“不情不愿的领导者”。

管理者还要对付地球上最令人费解的材料：人。德国研究人员开展的一项研究发现，零售商店向出勤率高的学徒发放奖金后，缺勤率急剧上升（以前被认为正常的行为现在却有钱拿，这似乎让人觉得翘班被正式许可了）。IESE商学院（IESE Business School）和普尔管理学院（Poole College of Management）的学者的另一项研究发现，如果赋予员工更多权力让他们感受到了更大的业绩压力，有可能导致不道德行为增加。意外后果定律在工作场所俯拾皆是。

管理者自己据称也是人，也容易受认知偏误的影响。那些采取措施鼓励员工贡献想法的老板们是在为组织和团队做正确的事情。但是根据马里兰大学的朴贤善（音译）及合著者的研究，他们征求的意见越多，就越不可能奖励那些大胆发言的人。相反，他们会觉得全靠自己创造了可以畅所欲言的环境。这种反应值得称道吗？不。意料之中吗？是的。

诚然，管理者并不拯救生命，也不滋养年轻的心灵。即使是最好的管理者也会满口行话，让人抓狂。而最糟糕的老板会让人生不如死。但是管理者做的工作几乎总是不可或缺，常常不得人心，有时是硬着头皮做的，而且也相当难。人们时不时也该记住这一点。■



Technology investing

Venture capital's reckoning

Why there won't be a rerun of the dotcom crash

The venture-capital bull run of the past two decades transformed what was once a cottage industry in Silicon Valley into a huge machine for building globally dominant companies. Over \$600bn of venture funds were invested worldwide last year, nearly ten times the level a decade ago. Venture capital (VC) spread into new sectors, drew in new participants and became more global. Valuations rocketed as a sense took hold that the good times would never end.

Now the war in Ukraine, China's purging of its tech industry and rising interest rates mean capitalism's moon-shot machine is earthbound. Public markets were the first to be hit. The NASDAQ index, which is weighted towards technology companies, has fallen by nearly 30% so far this year in a gruesome reckoning. The amount of capital raised through initial public offerings so far in 2022 is down by about 50% globally and by more than 70% in America compared with the same period last year.

The public-market bloodbath is inevitably hurting the VC world. Losses in end-investors' public portfolios put pressure on their private ones. Pension funds and endowments that committed large amounts of "dry powder" to private markets are trying to preserve cash by asking VCs to slow their pace of investing. Because there are more crossover funds, such as Tiger Global Management, which invest in several corners of the capital markets, the connection between public and private valuations has strengthened. Global investments made by VC funds in startups in May were worth \$39bn, about 30% less than the monthly average for 2021. Already, 68% of VC funds are reporting markdowns of valuations in their portfolios.

Startups that rely on VC cash are, unsurprisingly, feeling the pain. Fledgling firms with little cash saved, especially in competitive sectors such as food delivery, will fare worst. And after a long boom, expect some dubious behaviour to be revealed. One concern is how interlinked tech firms might be. Some apparently profitable startups are earning money by providing services, from digital marketing to cloud computing, to other startups that are losing money and that in turn rely on endless blank cheques from their VC sponsors.

Pessimists note that VC slumps take years to bottom out. Downturns caused by inflation and an oil shock meant the amount of money flowing into VC funds fell by 94% between 1969 and 1975. After the peak of the dotcom bubble, the rate at which VC funds deployed capital fell for more than two years.

Yet despite all this, the correction will not be as bad as the crash of 2000-01. For one thing, plenty of startups have built up war chests and so have healthy balance-sheets. Assuming a typical cash-burn rate, all but three of the 70-odd biggest software startups have raised enough funds to last until 2025.

The VC industry is more institutionalised, too. Self-sustaining VC networks from Europe to Asia are less dependent on flighty American capital and have enduring links to local financial firms and entrepreneurs. End-investors such as pension funds and endowments have experienced enough of tech's transformative effect on the economy to know not to run away.

Most important, the opportunity for innovation remains vast. The potential market for technology products has expanded hugely, beyond the bastions of business and consumer computing, to affect all parts of the business world, from biotech to supply-chain monitoring. What emerges from the

chaos will be a leaner and more efficient industry—and one that will remain a powerful force. ■



【首文】技术投资

风险资本大清算

为什么互联网崩盘不会重演

过去二十年里的风险投资牛市把硅谷一个小打小闹的行业变成了一台巨大的机器，打造出一个个称霸全球的公司。去年，全球风险基金投资超过6000亿美元，几乎是10年前的10倍。风险资本扩散到新的领域，吸引了新的参与者，变得更加全球化。人们觉得好日子永远不会结束，在这种情绪的烘托下，估值一飞冲天。

如今，由于乌克兰战争、中国整治科技行业以及利率上升，资本主义的登月机器已经搁浅。公共市场首当其冲折翼。偏重科技公司的纳斯达克指数今年以来已跌去近30%，令人不寒而栗。与去年同期相比，2022年迄今为止通过IPO筹集的资金总额在全球范围内下降了约50%，在美国下降了70%以上。

公开市场遭血洗，正不可避免地损伤风投界。终端投资者的公共投资组合亏损，给他们的私人投资组合带来了压力。向私人市场投入了大量“干火药”的养老基金和捐赠基金正要求风投放慢投资步伐，以求保存现金。由于有更多像老虎全球管理（Tiger Global Management）这样的交叉基金投资于资本市场的若干角落，上市公司和私人公司估值之间的联系加强了。今年5月，风投基金对创业公司的全球投资价值390亿美元，比2021年的月平均水平低约30%。已经有68%的风险投资基金报告其投资组合估值下调。

依赖风投资金的创业公司自然也感受到了痛楚。没有什么现金储备的羽翼未丰的公司麻烦最大，尤其是在竞争激烈的行业，例如送餐。而在经历了一轮长期繁荣之后，一些可疑的操作将暴露出来。一个担忧是科技公司之间的关联度有多高。一些表面上盈利的创业公司的赚钱方式是向其他创业公司提供从数字营销到云计算的各式服务，而后者在亏损而依赖风投金主不断大开支票。

悲观主义者指出，风险投资的低迷要多年才能见底。1969年至1975年间，通货膨胀和石油危机导致的经济衰退致使流入风投基金的资金减少了94%。互联网泡沫的顶峰过后，风投基金的资本配置速度持续放缓了两年有余。

尽管如此，这次调整不会像2000到2001年的崩盘那么糟糕。一方面，许多创业公司已经建立了储备金，因而拥有健康的资产负债表。按一般的烧钱速度来看，最大的七十来家软件创业公司中除三家之外，筹集到的资金都足够撑到2025年。

风投行业也已变得更制度化。从欧洲到亚洲，自给自足的风险投资网络不再那么依赖反复无常的美国资本，而与本地金融公司和企业家建立起了持久的联系。养老基金和捐赠基金等终端投资者已多次见识科技对经济的变革作用，足以让它们明白不要急于撤资。

最重要的是，创新的机会仍然巨大。技术产品的潜在市场已经大大扩展，冲出了商业和消费者计算的堡垒，影响着从生物技术到供应链监控的商业世界的方方面面。从混乱中破茧而出的将是一个更精简、更高效的行业——它仍将是一股强大的势力。■



State capital

The rise of China's VC-industrial complex

The state is reshaping one of the world's biggest startup scenes—not necessarily for the better

A high-tech development zone in the city of Wuhan has been abuzz since March, when the local government announced the creation of a 10bn-yuan (\$1.5bn) investment vehicle. The Optics Valley Hi-Tech Venture Capital Guidance Fund aims to combine the animal spirits of private capital with the industrial objectives of the state. Its general manager, Li Yang, told state media in late May that more than 80 private investors had submitted formal proposals. Ten of these are already in the process of being approved.

State cash is pulsing through China's private-capital markets. Between 2015 and 2021 around 2,000 so-called "government guidance funds" collectively raised almost \$1trn. Although the pace of fundraising has slowed since its peak in 2016, not least to allow the vehicles to deploy their copious dry powder, the government's role has been entrenched. Last year the state (including local governments) accounted for one-third of all capital raised in Chinese limited partnerships, making it by far the country's biggest source of venture capital (VC) and private equity (see chart 1).

According to Bain, a consultancy, most big Chinese funds that completed fundraising rounds in 2021 were government-led. The Enterprises Reform Fund raised nearly \$11bn; the National Green Development Fund brought in \$14bn. Provinces set up 20 such vehicles last year, marshalling about 136bn yuan all told, four and a half times as much as they raised in 2020, according to Zero2IPO, a research firm. Cities and other local governments chipped in more (see chart 2).

Guidance funds have a dual aim. They are meant to counter the "disorderly

expansion of capital” (Communist Party speak for China’s consumer-internet industry getting too big for its boots). And they are designed to fulfil President Xi Jinping’s desire for home-grown innovation in strategic areas such as artificial intelligence (AI), biotechnology and advanced manufacturing, notably of chips.

On paper, combining patient capital from the state with the animal spirits and market savvy of private investors allows the guidance funds to avoid the pitfalls of conventional industrial policy. By the government’s own reckoning, failure to mobilise private capital would make the funds into just another state subsidy. In practice, the role of the private sector is fuzzy and constricted. As a result, many of the vehicles resemble old-school handouts, complete with oodles of waste and cronyism. And they bring fresh problems.

Guidance funds are strange beasts. In a conventional VC or buy-out fund its originator acts as the general partner tasked with deploying the capital. A guidance fund, by contrast, often creates sub-funds in which it is a limited partner, and invites professional asset managers to be the general partner calling the shots. To limit the fund’s sway over the general partner’s investment decisions—and thus government meddling in where the money goes—many funds have rules dictating the maximum size of their investments. The Optics Valley fund’s stake in any one of its sub-funds must not exceed 25%, for example, and it can funnel no more than 100m yuan to any one of these sub-funds.

In some cases these rules appear to work well enough. Shanghai Angel Guide Venture Capital, a 10bn-yuan vehicle originally launched in 2014, has created more than 65 sub-funds that invest small amounts in minority stakes at early-stage companies in partnership with non-state investors. A review by The Economist of a sample of 20 of these sub-funds shows that their general partners and most of their remaining limited partners are

indeed private-sector funds. Judging by publicly available profiles, individual executives in charge of the sub-funds on behalf of the general partners have professional experience in investment.

Beyond China's largest cities, though, the situation is likely to look less like Shanghai and more like Shandong. In 2018 the eastern province set up the New Growth Drivers Fund. Since then the vehicle has launched more than 270 sub-funds and its cash has found its way into at least 1,000 provincial companies. Our analysis of 50 of these sub-funds reveals that about half are dominated by state capital with little private-sector co-investment. Instead, many of the remaining limited partners are other guidance funds, state-run firms or various government-linked entities. The individuals charged with managing these sub-funds also appear to have much less market experience than their counterparts in Shanghai.

The Shandong example suggests that at least in some cases state cash is crowding out private capital rather than co-opting it. One reason is the sheer number of government investors seeking to deploy capital. By 2019 there were more than 1,300 city and district guidance funds. One city in central China has at least ten of them, according to the Centre for Security and Emerging Technology, an American think-tank. With all the government money sloshing around, private investors have fewer places to park their capital.

The structure of the sub-funds, meanwhile, reduces their appeal to private investors. Many lock up money for up to ten years, in line with Mr Xi's exhortation to think long-term, but twice too long for the typical private limited partner. State guidelines for recognising investment losses are often stricter than venture capitalists or private-equity managers would like, and less patient towards struggling firms that could be helped through a rough patch. Most frustratingly, one lawyer notes, if a guidance fund with a small stake in a sub-fund decides to pull out, its preferential terms will

cause the dissolution of the entire vehicle, leaving both the portfolio firms and private investors out to dry.

The flood of state cash is leading to other distortions, too. One is the inflating of company valuations. An analysis by *The Economist* of company ownership records shows that of the 56 unicorns based in six central and eastern provinces, 32 have received state funding. Some of them belong to the herd of consumer-internet darlings whose prospects—and therefore worth—have been dented by Mr Xi's heavy hand. The local officials in charge of these investments have little incentive to recognise those losses, regardless of what their funds' guidelines say.

| *Guiding principles*

Frothy valuations are also a problem for the sort of startup Mr Xi approves of. Buy-out financiers report that hot industries such as chipmaking and AI have absorbed record levels of guidance capital in the past two years. The resulting bubblieness in the market has made it even tougher to pick out the real innovators from a sea of wannabes, notes Scott Kennedy of the Centre for Strategic and International Studies, a think-tank in Washington.

This problem is exacerbated by another, perhaps even more consequential distortion. Venture capital typically plugs young enterprises into a network of talent and potential business partners. Guidance funds instead give them direct links to state-owned companies and other government bodies that can fast-track applications and help with regulatory problems. Both startups and private co-investors are therefore highly motivated to connect with government funds, says Catherine Chen of Zhong Lun, a law firm in Beijing.

As Mr Xi's state capitalism becomes more statist and less capitalist, such connections can make or break fledgling businesses. This in turn gives startups and their private backers a powerful incentive to curry favour with

the government first and commercialise actual breakthroughs a distant second.

This appears to be happening. Having for years tailored their business to qualify for local subsidies, cheap credit and land, young Chinese companies are now doing the same to attract guidance funds. They and their private backers often enlist former government officials to help them navigate the new VC bureaucracy. One prominent venture capitalist admits that his VC firm now bets not so much on the next big thing as on the next sector in line for handouts. This makes perfect investment sense in today's China. It is not exactly a recipe for technological progress. ■



国家资本

中国风投产业综合体的崛起

中国政府正在重塑全球最大的创业基地之一——未必会向好

今年3月，武汉一个高新技术开发区开始热闹起来，因为当地政府宣布创建一个100亿元的投资工具。这个“光谷创业投资引导基金”旨在把私人资本的活力与国家的产业目标相结合。基金经理李扬在5月底对官方媒体表示，已有80多家私人投资者递交了正式申请。其中10个已进入审批环节。

政府资金正活跃于中国的私人资本市场。2015年至2021年间，大约2000家所谓的“政府引导基金”总共筹集了近一万亿美元。尽管募资的步伐自2016年达到顶峰后有所放缓（主要是为了让这些基金能够去部署其大量的储备资金），但政府的地位已经确立下来。去年，国家（包括地方政府）资金占到中国有限合伙募资总额的三分之一，由此成为中国风险投资和私募股权毫无疑问的第一大资金来源（见图表1）。

咨询公司贝恩（Bain）表示，2021年完成募资的中国大型基金大多由政府主导。国资国企综改基金筹集了近110亿美元；国家绿色发展基金融资140亿美元。研究公司清科的数据显示，去年各省设立了20个类似的融资平台，总共筹资约1360亿元，是2020年的4.5倍。市级和其他地方政府的募资还要更多（见图表2）。

设立政府引导基金有双重目的。一是要对抗“资本的无序扩张”（共产党对中国消费互联网行业自负越界的称法）。二是要实现国家主席习近平在人工智能（AI）、生物技术、先进制造（尤其是芯片）等战略性领域里自主创新的愿望。

理论上，将国家的长期资本与私人投资者的活力和市场敏锐度结合起来，可以让引导基金避开一些传统产业政策的陷阱。中国政府自己有数，如果不能调动私人资本，这些基金只会成为一种变相的国家补贴。但在实践中，私营部门的作用并不明晰且受到限制。因此，许多融资平台就像传统

的政府拨款，而且充斥着浪费和任人唯亲。而它们带来了全新的问题。

引导基金是头怪兽。在传统的风险投资或并购基金中，发起人担任负责资金配置的普通合伙人。相比之下，引导基金通常会创建子基金并作为有限合伙人参与其中，同时聘请专业的资产管理经理担任普通合伙人来做决策。为了限制基金对普通合伙人投资决策的影响——这种影响让政府能干预资金的流向——许多基金都有出资上限的规定。例如，光谷基金规定，其在单只子基金中的出资比例不得超过25%，并且出资额不得超过1亿元。

有时候这些规定看似很管用。上海市天使投资引导基金成立于2014年，规模为100亿元。目前该平台已经创建了逾65只子基金，这些子基金与非政府投资者合作，向初创期企业做小笔投资获得少数股权。本刊查看其中20只子基金后发现，它们的普通合伙人和其余大部分有限合伙人确实都是私营部门基金。从公开的资料来看，代表普通合伙人掌管子基金的高管们具有非常专业的投资经验。

不过，除了中国最大的几个城市，其他地方的情况很可能不太像上海而更像山东。2018年，这个东部省份设立了新动能基金。自那以来，该平台已经推出了270多只子基金，至少投资了1000家本省企业。本刊对其中50只基金的分析显示，大约一半由国有资本主导，并且几乎没有私营部门跟投。相反，其余的有限合伙人有许多是其他引导基金、国有企业或者各种与政府有关联的实体。这些子基金的管理者的市场经验似乎也比上海同行少得多。

山东的情况表明，至少在某些时候，政府资金是在排挤而不是在联合私人资本。原因之一是寻求配置资金的政府投资者数量太多了。截至2019年，中国市级和区级的引导基金达到1300余家。根据美国智库安全与新兴技术中心（Centre for Security and Emerging Technology）的数据，中国一个中部城市至少有10只这样的基金。由于遍地都是政府资金，私人投资者可投资的地方越来越少。

与此同时，这些子基金的结构也减少了它们对私人投资者的吸引力。许多

子基金的资金锁定期长达十年，这符合习将目光放长远的告诫，但对一般的私人有限合伙人来说拉长了一倍不止。政府关于认定投资损失的指导方针往往比风险投资者或私募股权经理所乐见的更严格，而在帮助困境中的公司度过难关方面耐心更少。一位律师指出，最令人沮丧的是，如果一只子基金中拥有少量股份的引导基金决定退出，它的优先条款会导致整个平台解体，置投资组合中的公司和私人投资者于不顾。

大量涌入的政府资金也导致了其他扭曲。一是公司估值虚高。本刊对企业所有权记录的分析显示，设在六个中东部省份的56家独角兽企业中有32家获得了政府资助。其中有些属于消费互联网行业宠儿，它们的前景因为习的重拳打击而折损，因而价值也打了折。负责这些投资的地方官员没有什么意愿去承认这些损失，不管其基金指导方针是怎么说的。

| 指导原则

即使是那类受到习认可的创业公司，估值泡沫同样是个问题。并购融资人士表示，过去两年里，芯片制造和人工智能等热门行业吸收了创纪录的引导资金。由此产生的市场泡沫使得要从一大堆模仿者中筛选出真正的创新者变得更加困难了，华盛顿智库美国战略与国际问题研究中心（Centre for Strategic and International Studies）的斯科特·肯尼迪（Scott Kennedy）指出。

这个问题因另一种扭曲而加剧，后者带来的后果可能更为严重。风险投资通常会把新生企业带入一个人才和潜在商业伙伴的网络。而引导基金却让它们与国有企业和其他政府机构建立直接联系，这些机构可以快速审批各种申请，并帮助解决监管相关问题。创业公司和私人共同投资人因而热衷于与政府基金建立关系，北京中伦律师事务所的陈芳表示。

随着习治下的国家资本主义变得更倒向国家主义而更少资本主义，这种与政府基金的关系能决定羽翼未丰的企业的成败。这就给了创业公司及其私人投资者强大的动力来把巴结政府当作第一要务。相比之下，实现突破并创造收入变得太过次要了。

这似乎正在发生。多年来，中国的年轻企业调整自己的业务以符合资格获得地方补贴、低息贷款和廉价土地，现在它们正在做同样的事来吸引引导基金。它们及其私人投资者通常会聘请前政府官员帮助自己搞定新的风投官僚机构。一位著名的风险投资家承认，他的风投公司现在与其说是押注于下一个大事件，不如说是押注于下一个即将拿到政府拨款的行业。在中国，这么做在投资上合情合理，但却未必是技术进步的良方。■



Schumpeter

Mars Inc gets the purpose v profit balance right

Showy corporations should learn from the low-key, family-owned mammal-feeder

The spiritual home of Mars Inc is Slough, an unprepossessing town somewhere under the flight path to London's Heathrow Airport. It is not a place that sweet dreams are made of. It serves as the British backdrop for Ricky Gervais's "The Office". It is also the place where Forrest Mars, in the Depression of the 1930s, came up with two business ideas and a management philosophy that are still quietly shaping the world today.

The creation story of the Mars Bar is well known. In 1920s Chicago, Forrest Sr, as he is now remembered, met his estranged father, a struggling chocolatier, over a malted milk, and came up with the brainwave of pouring malted milk chocolate as filling into a candy bar. Thus was the Milky Way born. But Forrest Sr, as irascible as he was enterprising, fell out with his father, left America and ended up in Slough. There, he rechristened the Milky Way as the Mars Bar. At a time when people needed calories at low cost, it took off. With brands like M&M's, Mars, based since 1974 in McLean, Virginia, is now the world's biggest confectioner.

Less familiar is the origin of the dark horse of the Mars empire, pet food. In Slough, Forrest Sr noticed the Brits' obsession with dogs. He did not like the way they ate scraps off the table. So in 1935 he bought a company that made Chappie, a tinned dog food. Today Mars reckons it caters to half the world's pets. Royal Canin, maker of a fancy dog chow, is its biggest brand. It is one of the largest providers of veterinary care. On June 22nd the company announced that Poul Weihrauch, head of pet care, would take over from Grant Reid, its retiring CEO. Mr Weihrauch's elevation partly reflects the growing importance of the pet business, which now generates 58% of sales, overtaking snacks (38%). Food accounts for the rest.

The family-owned company, though fiercely private about its finances, also updated its sales figures. They showed that since Mr Reid took office in 2014, revenues have increased by more than 50%, to \$45bn. That makes them bigger than Coca-Cola's. The firm gives credit for its success to the austere business practices Forrest Sr honed in Slough, now known internally as the Five Principles: quality, responsibility, mutuality, efficiency and freedom. They may sound like managerial guff. But they strike the right balance between making money and doing good. Many more showy corporations aim for that under the trendy slogan of "stakeholder capitalism". Few carry it off as convincingly as Mars.

To understand why, first consider the relationship between the company and its only shareholders, the family—a dynasty worth about \$96bn, according to Forbes magazine. The fourth generation, known as G4, runs the board. Like shareholders everywhere, they have varying priorities, ranging from sustainability to the welfare of "associates" (Martian for employees). Yet their mandate for steering the firm puts top-tier financial performance and long-term growth on a par with positive social impact and trust.

The shareholders reap less than a tenth of profits as dividends. That frees Mars to plough the rest back into its business, letting it keep a strong balance-sheet and a staunchly independent streak. They lead low-key lives. That fits with Mars's egalitarian ethos and preference for privacy. They also retain some of Forrest Sr's eccentricities. A former board member recalls factory visits with family members where everyone tried mouthfuls of canned dog food in order to check its quality. "It's like pâté. You get used to it," he says. The practice continues—though "we don't come into work every day and chomp away," a current executive insists.

Next there is the firm itself. It has been professionally run since 2001. People who know Mars say the clan does not meddle much, provided

managers do not threaten to blow up the firm's—and hence the family's—reputation. Delegation of responsibility runs deep. Mars has a relatively flat management structure, in which bosses have no cushy perks such as personal parking spaces. Associates are given responsibility, even at a young age, to make big decisions. If they take a calculated business risk that goes wrong, so be it. If they behave unethically there is zero tolerance.

In business, the firm is competitive but not cut-throat, rivals say. It used to be notable mostly for a strong factory culture, operational efficiencies and returns measured in relation to its physical assets. But this is changing as the veterinary-services business has grown. Now it plays up the more intangible parts of the business. “If you meet a Mars guy, they will talk about brands and people all the time,” a rival executive says admiringly, noting its high pay and good employee-retention rates.

As for stakeholderism, or what Mars calls mutuality, it says it puts the interests of customers, workers, suppliers, communities and the environment alongside those of the family shareholders. That comes with some big investments, such as \$1bn to support sustainable initiatives such as renewable energy, and a policy of paying its taxes in full. But when it talks about these publicly, it is mostly because they are germane to its business. It does not wade into political debates, nor does it pontificate on every social issue.

What about the future? With low debt, lots of cash and products resilient to economic turbulence, Mars is in a strong position to expand further. Some of its competitors, such as Kellogg, a food company, are flogging parts of their business. Mars bought Wrigley, a maker of chewing gum, during the financial crisis in 2008—not its finest acquisition, to be sure, but one it has stuck with. It may snap up more during today's inflationary turmoil.

| *Willy Wonka moment*

It won't discuss strategy, however. Though the family is more open about its commitments to society, it keeps business matters tightly under wraps. That legacy, which also dates back to Forrest Sr, may start to change. In 2020 Mars opened the Slough factory to TV cameras for the first time. Its chocolate-makers were, anticlimactically, locals in hairnets, not Oompa Loompas. But at least some of the secrets of Snickers' nougat filling were revealed. ■



熊彼特

玛氏公司达成使命和利润的平衡

那些高调的公司应该向这家低调的家族食品公司学习

玛氏食品的精神家园在斯劳（Slough），一个位于抵达伦敦希思罗机场的航路下方的不起眼的小镇。这不是一个浪漫梦幻的地方。瑞奇·贾维斯（Ricky Gervais）编剧的英版《办公室风云》（The Office）以这里为背景。同样是在这里，上世纪30年代大萧条时弗雷斯特·玛氏（Forrest Mars）提出了两个商业创意和一套管理哲学，它们至今仍在默默地影响着世界。

玛氏巧克力棒诞生的故事众所周知。在上世纪20年代的芝加哥，老弗雷斯特（后人现在这么称呼弗雷斯特·玛氏）和疏远多年的父亲重聚，做糖果生意的父亲经营困难。老弗雷斯特看着面前的那杯麦芽饮料，冒出了将巧克力麦芽饮料制成糖果棒的灵感。银河棒（Milky Way）就这样诞生了。然而老弗雷斯特虽富有创业精神，但也脾气暴躁，后来与父亲闹翻，离开了美国，最终来到了斯劳。在那里，他把银河棒改名为玛氏巧克力棒。在人们需要低成本卡路里的年代，这款产品大获成功。1974年，玛氏食品将总部设在了弗吉尼亚州的麦克莱恩市（McLean），凭借M&M's等品牌，它如今已成长为世界上最大的糖果制造商。

作为玛氏帝国的一匹黑马，宠物食品的源起就没那么广为人知了。在斯劳，老福雷斯特注意到英国人痴迷养狗。他不满意狗只能吃残羹剩饭，因此在1935年收购了罐头狗粮Chappie的生产商。现在，玛氏估计自己满足了世界上一半宠物的胃口。高档狗粮制造商皇家宠物食品（Royal Canin）是玛氏最大的品牌，是最大的宠物营养保健供应商之一。6月22日，玛氏宣布宠物护理事业部主管保罗·维拉赫（Poul Weihrauch）将接替退休的CEO格兰特·里德（Grant Reid）。维拉赫的晋升在一定程度上反映了宠物业务日益增长的重要性，该业务现在占公司销售额的58%，比例超过了零食（38%）。其余部分属于食品。

这个对财务数据守口如瓶的家族企业也更新了销售数据。数据显示，自里德2014年上任以来，收入增长了50%以上，达到450亿美元，超越了可口可乐。该公司将其成功归功于老弗雷斯特在斯劳磨练出来的朴素商业实践，如今公司内部将其称为“五大原则”——质量、责任、互惠、效率和自主。这听起来可能像是管理学的陈词滥调，但它们在盈利和为善之间取得了恰到好处的平衡。很多更高调的公司喊着“利益相关者资本主义”的流行口号，也以取得这样的平衡为目标，但很少有公司能像玛氏那样令人信服地践行它。

要理解个中原因，首先要考虑公司与其唯一股东玛氏家族之间的关系。据《福布斯》杂志报道，这个家族拥有价值约960亿美元的财富。被称为G4的家族第四代传人掌管着董事会。像世界各地的股东一样，他们有从可持续发展到“伙伴”（玛氏对员工的称呼）福利等不同的优先事项。然而，他们在授权管理公司时，把积极社会影响和信任看得和一流财务业绩及长期增长同等重要。

公司利润只有不到十分之一用来派息。这让玛氏可以把剩下的利润重新投入到业务当中，让它保持强劲的资产负债表和坚定的独立性。这些股东生活低调，符合玛氏的平等主义精神和对隐私的重视。他们还保留了老弗雷斯特的一些古怪行径。一位前董事回忆起与家人一起参观工厂时，每个人都试了几大口罐装狗粮来检查质量。“吃起来就像肉酱，吃吃就习惯了。”他说。这个做法还在继续——不过“我们也不会每天上班都大啃狗粮”，一位现任高管坚称。

另一个原因是公司本身。它自2001年以来一直由职业经理人经营。了解玛氏的人说，只要经理人看起来不会毁掉公司声誉——进而毁掉家族声誉，家族就不怎么干预。责任委派非常深入。玛氏的管理结构相对扁平，老板没有私人停车位等安逸福利。即使年轻的员工也会被委以重任，要做出重大决定。如果员工在慎重考虑后做出的业务冒险未能如愿以偿，那就坦然接受。但如果他们有不道德行为，那就是零容忍。

在商业中，对手们说玛氏积极竞争，但不会搞个你死我活。它过去主要以

强大的工厂文化、运营效率和按有形资产来衡量回报而著称。但随着宠物保健服务业务的发展，这种情况正在发生变化。现在它强调业务中更无形的那部分资产的重要性。“如果你遇到一个玛氏员工，他们会一直谈论品牌和人。”一位竞争对手的高管钦佩地说，同时还提到玛氏的薪酬水平和员工保持率都很高。

至于利益相关者主义——即玛氏所说的互惠——玛氏表示它把顾客、员工、供应商、社区和环境的利益看得和家族股东的利益一样重。这相应带来了一些大额投资，例如投资10亿美元支持可再生能源等可持续发展举措，以及全额纳税的政策。但当它公开谈论这些时，主要是因为它们与自身业务密切相关。玛氏不参与政治辩论，也不会自以为是地谈论各种社会问题。

未来呢？凭负债少、现金多和能够抵御经济动荡的产品，玛氏在进一步扩张上处于有利地位。食品公司家乐氏等竞争对手正在出售部分业务。玛氏在2008年金融危机期间收购了口香糖制造商箭牌，这当然算不上它最好的一笔收购，但却一直将箭牌保留了下来。在如今通胀高企的动荡时期，它可能还会做更多收购。

| 巧克力工厂敞开大门啦

但玛氏不会对外讨论策略。尽管该家族对自身的社会承诺更加公开，但它对商业事务仍然三缄其口。这个同样可以追溯到老福雷斯特的传统可能会开始改变。2020年，玛氏首次让电视台的摄像机进入了斯劳的工厂。叫人扫兴的是，制作巧克力的并不是矮人族奥帕-伦帕人（Oompa Loompas），而是戴着发网的本地人。但至少士力架牛轧糖馅的一些秘密被揭开了。■



A tale of three cities

The battle between Asia's financial centres is heating up

Hong Kong, Singapore and Shanghai each bring different advantages—and costs

“Another one!” was how a Singaporean manager of serviced apartments greeted your correspondent, fresh off the plane from Hong Kong. The response tells you which of the two cities is currently enjoying an influx of people and business. The latest impetus has been their contrasting approaches to the pandemic. Singapore began opening up to the rest of the world last year; by comparison, although the quarantine periods for arrivals to China and Hong Kong have been shortened, there is no sign yet of their end.

Hong Kong is widely seen as the third-most-important city for global finance and business, after New York and London, and ahead of Shanghai and Singapore. Most historians trace its rise as a financial centre to the early 1970s, when it became a hub for Asian offshore financing. Its importance then increased dramatically after China began to open up under Deng Xiaoping in 1978. Hong Kong was where Western bankers could mingle with Chinese businessmen while private-sector activity in the mainland was still finding its feet. The deals they made were governed by the territory's reliable regulatory framework and courts that made use of English law.

Yet even before the pandemic, the established order of Asia's global hubs was being thrown into doubt. Over the quarter-century since Hong Kong was returned to Chinese sovereignty, the mainland has tightened its grip on the territory's institutions. Under its influence, Hong Kong has introduced a sinister national-security law; the city's independent judiciary, long valued by foreign investors, has been weakened by political intervention. That has tarnished its appeal relative to Singapore, another entrepot with a

common-law legal system, business-friendly regulation and low taxes. Moreover, South-East Asia has become an increasingly desirable place for Western companies to do business, which, by virtue of proximity, further burnishes Singapore's allure. For firms intending to operate in China, meanwhile, the benefits of setting up in Hong Kong, rather than Shanghai, are diminishing.

How will the roles of these cities evolve in the face of such forces? To answer the question, consider three measures of the importance of a city for global business and finance: its use as a base for conducting regional or global business; its position as a centre for wealth made elsewhere to be managed and invested; and the size of its capital market and the banking activities associated with it.

Start with where business is. Hong Kong's status as a regional base for global firms was always tied to China, but that relationship has become more intimate still in recent years. The number of Chinese firms with regional headquarters in the territory has doubled since 2015, even as the number of American firms using the city as a base for their Asian or greater China operations has steadily declined (see chart).

Singapore does not produce similar statistics, but a flurry of recent openings by big firms is illustrative. Sony Music, an American entertainment company; Dyson, a British home-appliance maker; and VinFast, a Vietnamese maker of electric vehicles, have all set up regional or global headquarters there in recent years. Chinese tech firms including Alibaba, TikTok and Tencent have done so, too, led by their need to be outside China's "great firewall" in order to run their global operations.

Singapore has publicly been ambivalent about stealing business from Hong Kong. Lee Hsien Loong, the city-state's prime minister, has welcomed expats, but said that he would be just as happy if they felt able to remain in

Hong Kong, contributing to the region's dynamism. In the background, however, the approach is less magnanimous. The city's sharp-elbowed investment-promotion agency works to help would-be migrants with visas and business registrations.

Shanghai had attracted Western outposts before the pandemic. Some firms, such as Coca-Cola, had moved their Asia headquarters there from Hong Kong. Regulatory changes in 2020 allowed foreign investment banks to run majority-controlled businesses in China. Several have consequently expanded their operations in Beijing and Shanghai. Foreign asset managers including Amundi and BlackRock have also scaled up their onshore presence.

The city's grim lockdowns may have cooled that ardour in the near term. In a recent survey by the American Chamber of Commerce in Shanghai, only one American firm out of 133 planned to increase its investment in China. Yet for firms intending to have some exposure to the mainland, Shanghai may ultimately prove unavoidable. The more Hong Kong comes under China's thumb, the less unattractive being based on the mainland becomes.

China may be more draconian in its approach both to governance and covid-19, but it is at least home to vast numbers of suppliers and customers. "If you want to be in China, it will be increasingly important to be onshore and close to your clients and companies," says Christian Brun of Wellesley, an executive-recruitment firm for the financial-services industry. Mr Brun predicts job growth on the mainland and in Singapore, with fewer roles for expats in particular in Hong Kong. (He himself has moved from Hong Kong to Singapore.)

A second gauge of the cities' relative dominance is wealth management. It is here that the competition between Hong Kong and Singapore has been fiercest. By one measure, Hong Kong's pot of assets under management and

fund advisory rose from nearly \$1.3trn in 2010 to more than \$3trn in 2020. But a comparable measure for Singapore shot up from around \$1trn to \$3.4trn, with the city overtaking Hong Kong as long ago as 2017. Its simple laws for establishing trusts and its tax efficiency have attracted wealth to it. A new form of investment vehicle launched in 2020, the variable-capital company, has also proved popular with fund managers.

Hong Kong has been squeezed in other areas of investment management, too. Of the 20 largest managers of venture-capital funds globally, measured by capital raised in the past decade, seven were in Beijing, Shanghai or Shenzhen. Venture capitalists hoping to cash in on South-East Asia's boom have chosen Singapore as a base. The city's closer links with Indian firms are also an attraction.

When it comes to capital markets and investment banking, our third gauge of the cities' importance, though, Hong Kong retains its crown. With China's government showing no sign of allowing capital to flow freely in and out of the mainland soon, the territory's value as a gateway remains. It hosts the Connect programmes that allow foreign investors to trade onshore bonds and equities, and Chinese punters to trade stocks in the territory. Three-quarters of all transactions in yuan made through the SWIFT interbank-messaging system are booked in Hong Kong. The territory has been a hub for Chinese firms to list in recent years, including Alibaba and jd.com in 2019 and 2020 (though few have come this year). Overall, the value of the city's listed stocks runs to nearly \$5trn, compared with \$7trn in Shanghai and \$700bn in Singapore. That in turn has helped Hong Kong sustain an edge in global banking, even though some desks have moved to Singapore to skirt the territory's quarantine rules.

Hong Kong, then, will remain a route to investing in China. But it may be less likely to attract other sorts of new business. The companies that do move there are more likely to be Chinese. To others, Hong Kong's delay in

reopening seems to typify its indifferent approach to its global status. Faced with it, firms seeking to do business in Asia more broadly may choose Singapore. And those wanting to do business in China may expand their presence onshore instead. Where Hong Kong alone used to suffice, some firms may start to see a Shanghai-and-Singapore strategy—which uses the first for operations in China and the second for those in the rest of Asia—as an attractive long-term bet. ■



三城记

亚洲金融中心之争日渐升温

香港、新加坡和上海各有利弊

“又来一位！”笔者从香港飞抵新加坡入住服务式公寓时，接待经理是这么说的。从这一反应可以看出这两座城市中的哪一个正在迎来人员和生意涌入。最新的一股推动力是这两地截然不同的防疫政策。新加坡去年重新向世界开放，相比之下，尽管中国大陆和香港的入境隔离时间已经缩短，但仍未有取消的迹象。

人们普遍认为香港是全球第三大金融商业都会，仅次于纽约和伦敦，排在上海和新加坡之前。大多数史学家认为，香港崛起为全球金融中心始于上世纪70年代初，它在那时成为了亚洲离岸融资枢纽。1978年，中国大陆在邓小平的领导下开始推行改革开放，香港的重要性急剧提高。那时大陆私营经济仍在摸索前行，西方银行家可以在香港与大陆商人接触来往。他们达成的交易受香港可靠的监管框架和使用英国法律的法院管辖。

然而，即便在新冠疫情发生前，亚洲的全球枢纽城市的既定排序就已经存疑。中国政府对香港恢复行使主权25年来，对该地区的制度已经收紧管控。在其影响下，香港出台了一部严苛的国安法，其长期以来备受外国投资者珍视的独立司法体系因政治干预而削弱。这使得它相比另一转口港新加坡的吸引力下降，后者拥有普通法体系、宜商监管制度和低税率。而且西方公司越来越把东南亚视为理想的营商之地，近水楼台的新加坡因而更添魅力。同时，对于打算在中国开展业务的公司来说，相比上海，在香港落脚的有利之处也在减少。

面对这样的局势变化，这几个城市的角色将如何变迁？为回答这个问题，来看看衡量一个城市在全球商业和金融中的重要性的三个标准：作为区域或全球业务据点的作用；作为外地所得财富管理和投资中心的地位；资本市场及相关银行活动的规模。

先看业务据点。香港作为跨国企业区域基地的地位一直都与中国大陆相关联，而这种关系近年来变得越发密切。自2015年以来，在香港设立区域总部的大陆企业数量翻倍，与此同时以香港为亚洲或大中华区业务基地的美国公司数量却持续下降（见图表）。

新加坡没有类似的统计数据，但近期大公司纷纷涌入就很能说明问题。美国娱乐公司索尼音乐、英国家电制造商戴森，以及越南电动汽车制造商VinFast近年都在新加坡设立了区域或全球总部。出于在中国防火墙外运作全球业务的需要，阿里巴巴、TikTok和腾讯等中国科技公司也已入驻。

对于抢夺香港的业务，新加坡的公开立场一直模棱两可。这个城市国家的总理李显龙表示欢迎外籍人士，但又说，如果他们觉得可以留在香港为该地区的活力做贡献，他一样高兴。但背后的做法就没那么豁达了。新加坡手段犀利的投资促进机构正设法协助潜在移居者办理签证和商业登记。

疫情前，上海吸引了不少西方公司前来开设分支机构。可口可乐等公司把亚洲总部从香港迁至上海。2020年的法规变动允许外国投资银行在华设立控股公司。一些投行因而扩大了在北京和上海的业务。东方汇理（Amundi）和贝莱德（BlackRock）等外国资产管理公司也扩大了在中国大陆的业务规模。

上海严厉的封城措施也许在短期内冷却了这股热情。上海美国商会最近的一项调查显示，133家美国公司中只有一家计划扩大在华投资。然而，对于打算多少都要有些中国大陆业务的公司来说，最终可能免不了要立足上海。香港越受制于中央政府，把业务据点设到大陆这个选项的“不讨喜”程度就越低。

中国大陆的治理和防疫也许都要更严厉，但那里至少是大量供应商和客户的所在地。“要在中国发展，越来越重要的一点就是要立足当地，靠近客户和那里的公司。”金融服务业高管猎头公司Wellesley的克里斯蒂安·布伦（Christian Brun）指出。他预测中国大陆和新加坡会出现就业增长，而香港的职位会减少，尤其是外国人的职位。（他本人已经从香港搬到了

新加坡)。

衡量这些城市相对优势的第二个标准是财富管理。在这方面，香港和新加坡的竞争最为激烈。按一项指标测算，香港的资产管理及基金咨询规模已从2010年的近1.3万亿美元上升到2020年的超过三万亿美元。新加坡的同类指标从约一万亿美元飙升至3.4万亿美元，在2017年就已超越香港。新加坡设立信托的法律简明，税制高效，吸引了财富流入。可变资本公司这种在2020年推出的新式投资工具也受到了基金经理的追捧。

香港在投资管理的其他领域也受到挤压。按过去十年的融资额计算，全球20家最大的风投基金管理公司中有七家在北京、上海或深圳。想从东南亚的发展中获利的风险投资家已选择新加坡作为基地。这座城市与印度企业的联系更紧密，也是它的一个吸引人之处。

至于说衡量城市重要性的第三个标准，也就是资本市场和投资银行，香港仍保有王者地位。未有迹象表明中国政府会在短期内允许资本自由进出大陆，香港仍将保持作为出入门户的价值。通过香港的“互联互通”机制，外国投资者可以买卖大陆债券和股票，大陆投资者也可在香港交易股票。在经由银行间电讯系统SWIFT进行的所有人民币交易中，四分之三是在香港登记的。近年来，香港成了大陆企业上市的集中地，例如分别在2019年2020年在港交所挂牌的阿里巴巴和京东（不过今年不多）。香港上市公司的总市值接近五万亿美元，上海为七万亿美元，新加坡为七千亿美元。这又帮助了香港保持在全球银行业中的优势，即便部分业务板块已转至新加坡以避免香港的检疫隔离措施。

所以，香港仍将是投资大陆的一条路径，但也许不太能吸引到其他类型的新业务。转战香港的更有可能是大陆公司。在其他公司看来，香港迟迟不重新开放似乎表明了它对自己的全球地位漫不经心。面对这种情况，想在亚洲拓展业务的公司可能会选择新加坡。想在中国经营的公司则可能转而扩大在大陆的布局。过去只要扎根香港就够了，现在一些公司可能开始把“上海加新加坡”的战略（利用前者经营中国业务，利用后者经营亚洲其他地区的业务）看作理想的长远之计。■



The Economist Film

Solar geoengineering: is it worth it? (Part 2)

Arguments look set to intensify about the balance of risks and rewards.



经济学人视频

太阳地球工程值得推广吗？（下）

各界将就如何平衡其利弊展开激辩。



Pirates of Pyongyang

“The Lazarus Heist” explains North Korea’s wild hacking spree

The internet lets the hermit kingdom steal money from all over the world

The Lazarus Heist. By Geoff White. Penguin Business; 304 pages; \$29.95 and £20

The “hermit kingdom” of North Korea is so technologically backward that it is visible—or rather invisible—from space. Photographs taken at night show a country covered in darkness, with only a few pinpricks of light around Pyongyang, the capital. China, Japan and South Korea, by contrast, glow with artificial illumination.

But as Geoff White, a BBC journalist, explains in his rollicking new book, that backwardness has helped make a handful of North Koreans very technologically savvy indeed. He tells the story of the Lazarus Group, the name given by security analysts to a collection of North Korean state-sponsored hackers. In a country where access to the internet is a luxury afforded to only a tiny few, they have, over the past decade, become some of the world’s most prolific cybercriminals.

The Lazarus Group is thought to have been responsible for a \$100m raid on Bangladesh’s central bank in 2016; the WannaCry malware attack that in 2017 hit organisations around the world, from Maersk, a shipping giant, to Britain’s National Health Service; and a string of more recent hacks and cryptocurrency frauds. The group’s various schemes are thought to have netted billions of dollars of precious foreign currency for the North Korean regime.

“The Lazarus Heist”, which is based on a BBC podcast of the same name, provides both a pacy insight into the cutting edge of modern crime and an

equally fascinating portrait of life inside North Korea (gleaned from a mix of official sources and interviews with defectors). In theory, the regime preaches Juche, usually translated as “self-reliance”, deliberately isolating itself from the decadent capitalism that contaminates the rest of the world.

But self-imposed isolation has left North Korea impoverished and underdeveloped. Its pursuit of nuclear weapons has brought sanctions, compounding the problem. With the economy strangled and citizens poor and sometimes starving, Mr White describes a state trying its hand at a variety of criminal schemes, from counterfeiting to smuggling and cooking crystal meth, in an effort to earn foreign currency. Eventually it alighted on computer hacking—especially electronic bank raids—as the most lucrative. A UN report of 2019 attributed 21 separate attacks to the Lazarus Group, most aimed at foreign banks.

Despite its technical topic, the book is breezily written. Well-observed pen portraits make the revolving cast of characters—Chinese underworld fixers, hapless bank employees, casino croupiers and hackers in rural England—easier to follow. Knotty details are skimmed over without sacrificing the crucial points, though at one stage Mr White guides the reader through a few lines of low-level computer code, perhaps to reassure the technically minded of his bona fides.

And the tales themselves need no embellishment. A bank clerk frustrated by a misbehaving printer comes to realise it was one of the few outward signs of a huge scam taking place under his nose. Bangladesh’s losses are limited by a piece of blind luck: a destination bank for the stolen money is located on Jupiter Street in Manila, and “Jupiter” happens to be the name of a shipping firm involved with Iran, which trips anti-fraud systems. The stolen Bangladeshi loot is laundered through the VIP baccarat tables of a Filipino casino; gangs of money mules pose as high-rollers yet seem oddly bored and listless while placing enormous bets.

Conspicuously missing, despite the title, are the stories of the hackers themselves. Mr White describes how mathematically talented children from across North Korea can be funnelled into what has become a prestigious job, offering better housing, social status and even occasional trips to the outside world. He shows how the hackers' sophistication has grown alongside their confidence. But North Korea's isolation, and the fact that the culprits remain safely ensconced thousands of miles from the targets of their heists, mean only one of them is ever given a name—Park Jin Hyok, whose face adorns the FBI's "Cyber Wanted List". And even that may be a pseudonym. ■



平壤大盗

《拉撒路大劫案》解释了朝鲜大举发动黑客攻击的始末

互联网让这个隐士王国得以从世界各地偷钱【《拉撒路大劫案》书评】

《拉撒路大劫案》。杰夫·怀特著。Penguin Business, 304页；29.95美元/20英镑。

从太空望去，朝鲜落后的科技让这个“隐士王国”清晰可见，或者更确切地说，让它隐匿难见。在夜间拍摄的照片里，朝鲜一片漆黑，只在首都平壤周围透出几缕微光。相比之下，中国、日本和韩国的人工照明让它们熠熠发光。

但正如BBC记者杰夫·怀特（Geoff White）在他轻松有趣的新书中所解释的那样，这种落后倒帮助了少数朝鲜人变得非常精通科技。他讲述了拉撒路集团（Lazarus Group）的故事，这是安全分析师给朝鲜政府支持的一群黑客起的名字。在一个只有极少数人才能享受上网的国家，这群黑客在过去十年中已跻身世界上犯案最多的网络犯罪分子之列。

2016年孟加拉国央行账户被窃取一亿美元。2017年，从航运巨头马士基（Maersk）到英国国家医疗服务体系（NHS）等世界各地的机构遭到WannaCry恶意软件攻击。还有更近些年来一系列的黑客攻击和加密货币欺诈案。这些都被认为是拉撒路集团所为。其种种犯罪勾当据信为朝鲜政权捞到了数十亿美元计的宝贵外汇。

《拉撒路大劫案》（The Lazarus Heist）一书改编自BBC同名播客，既能让读者快速洞悉最前沿的现代犯罪，也有同样引人入胜的朝鲜内部生活写照（资料来自各种官方消息源和对叛逃者的采访）。在理论上，朝鲜政权宣扬“主体思想”（Juche，通常被翻译为“自力更生”），有意将自己与毒害世界其他地区的腐朽资本主义隔绝开来。

但主动自我隔绝让朝鲜贫穷落后。它对核武器的追求招致制裁，让问题更

加复杂。朝鲜的经济毫无生气，人民生活窘迫，有时忍饥挨饿。怀特描述了其政府如何试图通过从造假到走私和制冰毒等犯罪勾当赚取外汇。最终，它发现计算机黑客攻击最有利可图，尤其是打劫电子银行。联合国2019年的一份报告认为有21起无关联的黑客攻击都是拉撒路集团所为，攻击对象多是外国银行。

尽管是谈论技术，这本书写得轻松活泼。作者对人物观察细致，描写生动，因此尽管他们如走马灯般穿梭来回——中国黑社会的中间人、倒霉的银行员工、赌场荷官、隐匿于英格兰乡间的黑客——读者也不会晕头转向。怀特在不牺牲关键线索的情况下略去了复杂的细节，不过在某一处，他带领读者解读了几行初级程序代码，也许是为了让懂技术的读者相信他是有真材实料的。

书中的那些故事本身无需润饰。一名银行职员因打印机出了故障而着急，后来才意识到一桩惊天劫案正在他眼皮底下发生，而这个故障正是为数不多的蛛丝马迹之一。如果不是撞了个大运，孟加拉的损失还会更大。被盗资金原本要转移到位于马尼拉朱庇特街（Jupiter Street）的一家银行，而一家与伊朗有关联的航运公司恰好也叫“朱庇特”，结果启动了反欺诈系统。被盗的孟加拉国资金在菲律宾一家赌场的贵宾厅被洗白——在百家乐赌桌上，成群的钱骡摆出一副赌场豪客的模样，但大笔下注时却显得没精打采，让人奇怪。

尽管标题点出了黑客，但书中显然没有太多关于黑客的故事。根据怀特的描述，来自朝鲜各地具有数学天赋的孩子被找来从事这项如今很有声望的工作，它提供更好的住房、更高的社会地位，甚至偶尔还让他们去到外面的世界。怀特的书让我们看到这些黑客如何越来越老练，也越来越自信。但由于朝鲜与世隔绝，黑客安居于距离抢劫目标数千英里之外的地方，外界只知道他们其中一人的名字——朴镇赫（音译），他的照片登上了联邦调查局的“网络罪犯通缉名单”（Cyber Wanted List）。可就连这个名字也可能只是个化名。■



Free exchange

People's inflation expectations are rising—and will be hard to bring down

Our first in a series on the central-bank pivot

Consumer prices across the rich world are rising by more than 9% year on year, the highest rate since the 1980s. Worryingly, there is growing evidence that the public is starting to expect consistently high inflation. Figures suggesting that Americans' medium-term expectations of inflation had risen helped set off the market turmoil in early June, which culminated in the Federal Reserve raising interest rates by three-quarters of a percentage point. Central banks urgently need to convince people that they are serious about getting inflation down. But a range of evidence suggests that changing the public's mind could be extraordinarily difficult.

The difference in views of expert and lay groups has become gaping. Bernardo Candia, Olivier Coibion and Yuriy Gorodnichenko, three economists, look at the inflation expectations of four groups in America. Those of professional forecasters and financial markets remain close to the Fed's target of 2%. But consumers' beliefs increasingly do not. They expect prices to rise by more than 5% over the next year. Firms, exposed to surging commodity, wage and other input costs, expect higher inflation still.

Expectations are rising outside America, too. A dataset put together by the Cleveland Fed, Morning Consult, a consultancy, and Raphael Schoenle of Brandeis University gauges public inflation expectations in various places. In May 2021 respondents in the median rich country thought inflation over the next year would be 2.3%. Now they expect a rate of 4.2%.

Central banks face a problem in getting these expectations down again. This is because few people, aside from investors and financial journalists,

pay much notice to what they say. A new paper by Alan Blinder of Princeton University and colleagues puts it more drily: “Households and firms have a low desire to be informed about monetary policy.” A survey in 2014 found that only a quarter of Americans could pick out Janet Yellen as the then-chairwoman of the Fed, from a list of four. Two-fifths of Americans believe that the Fed’s inflation target exceeds 10%. Small wonder that the impact of its policy announcements on inflation expectations is “muted”, according to a recent study by Fiorella De Fiore of the Bank for International Settlements, and colleagues.

Nor are Americans alone. In the late 2000s researchers at the Bank of Italy assessed whether people knew what inflation was. Many had only a fuzzy understanding—with half of respondents confusing price changes with price levels. In recent years Japan has implemented forceful monetary easing in order to boost inflation. But in 2021 more than 40% of Japanese people had “never heard” of the plan, according to an official survey.

In the years before the pandemic, public apathy to monetary policy did not much matter. Inflation was low and stable. Now it matters a lot. Spiralling expectations could become embedded in wages and prices, pushing headline inflation higher still. Central bankers’ conventional toolkits may do little to bring them down. Even the effect of raising interest rates is not totally clear: twice as many Americans believe that higher rates raise inflation than reduce it, according to a recent The Economist/YouGov poll.

What more can be done? History points to several options. One is to make drastic or unexpected announcements. This could involve raising interest rates outside of scheduled meetings—a decision taken by India’s central bank in May. The European Central Bank (ECB) has used this trick in pursuit of another goal: keeping down government-bond spreads, which would otherwise threaten a debt crisis. In 2012 Mario Draghi, then the head of the bank, made an impromptu promise to do “whatever it takes” to save the

euro. According to research by Michael Ehrmann of the ECB and Alena Wabitsch of Oxford University, the words generated high traffic on Twitter among non-experts, suggesting they had cut through. The genius of the statement, other research suggests, was that it focused on the end (“preserve the euro”) rather than the means (“buying bonds”), which is easier for the public to understand. The ECB has tried to repeat the trick more recently, such as by calling an emergency meeting to address widening spreads.

Others have played the long game. Paul Volcker, the Fed’s chairman from 1979 to 1987, cultivated a reputation as what economists call an inflation “nutter”: someone willing to tolerate high unemployment to defeat the beast. The public eventually got the message. A recent paper by Jonathon Hazell of the London School of Economics and others argues that post-Volcker “shifts in beliefs about the long-run monetary regime” proved more important than any other factor in conquering inflation before covid-19. Andrew Bailey, the head of the Bank of England, has been trying to embrace his inner Volcker, such as by giving Britons the impression that he cares more about inflation than he does their wages.

| *Public enemy number one*

Another solution is for politicians to get involved. This has potential drawbacks, because they often advocate crackpot anti-inflation schemes such as price controls. Still, they might be able to help. After all, 37% of Americans believe that the president has “a lot” of control over inflation, compared with 34% for the Fed. Jimmy Carter’s appointment of Volcker in 1979 showed that he was serious about getting inflation down. In Britain, Margaret Thatcher and her henchmen talked tough on price stability; their willingness to slash government budgets probably backed up those words, by cooling the economy. Today in America, President Joe Biden says that “fighting inflation” is his “top economic priority” (though he shows less

inclination to tighten fiscal policy).

Public apathy towards central banking may be a backhanded compliment to the policymakers of the 1980s and 1990s. No one needed to care about inflation when it was low. Today's policymakers are constrained by that very success. To get inflation expectations back down, then, they may need to try everything in their power to get people to sit up and listen. ■



自由交流

人们的通胀预期在上升——而且会很难降低

央行策略转向系列之一

富裕国家的消费者价格同比上涨超过9%，是上世纪80年代以来的最高水平。令人担忧的是，越来越多的证据表明公众开始预期通胀将持续居高不下。显示美国人中期通胀预期上升的数据助推了6月初的市场动荡，最终以美联储加息75个基点收尾。各国央行迫切需要让人们相信它们在努力降低通胀。但一系列证据表明，要改变公众的想法可能会异常困难。

专家和外行群体的观点分歧已经越来越大。三位经济学家伯纳多·坎蒂亚（Bernardo Candia）、奥利维尔·科比恩（Olivier Coibion）和尤里·格罗多尼琴科（Yuriy Gorodnichenko）研究了美国四个群体的通胀预期。专业预测机构和金融市场的预期仍接近美联储2%的目标，但消费者的看法与此偏离得越来越远，他们预期接下来一年里价格将上涨5%以上。而面对大宗商品、工资和其他投入成本的飙升，企业预期通胀还会攀升到更高。

美国以外的通胀预期也在上升。由克利夫兰联储、咨询公司Morning Consult和布兰代斯大学（Brandeis University）的拉斐尔·舍恩勒（Raphael Schoenle）汇总的一个数据集衡量了各地的公众通胀预期。2021年5月，中等富裕国家的受访者认为之后一年的通胀为2.3%。现在他们的预期为4.2%。

央行要再次降低这些预期可不容易。这是因为除了投资者和财经记者之外，很少有人会关注央行说了什么。普林斯顿大学的艾伦·布林德（Alan Blinder）及同事在一篇新论文中说得更直白：“居民和企业没太大的兴趣了解货币政策。”2014年的一项调查发现，只有四分之一的美国人能从四个人中认出时任美联储主席珍妮特·耶伦（Janet Yellen）。五分之二的美国人认为美联储的通胀目标超过10%。难怪美联储的政策公告对通胀预期影响“平淡”，国际清算银行的菲奥雷拉·德·菲奥雷（Fiorella De Fiore）

及同事最近的一项研究写道。

也不只美国人是这样。在2000年代后期，意大利央行的研究人员评估了人们是否了解什么是通货膨胀。许多人的理解都很模糊，一半的受访者把价格变化与价格水平混为一谈。近年来，日本实施了强有力的货币宽松政策以提振通胀。但一项官方调查显示，在2021年，超过40%的日本人“从未听说过”该计划。

在疫情之前的那些年里，公众对货币政策漠不关心问题不大。那时通胀低且稳定。而现在它变得非常要紧。螺旋式上升的预期可能会反映到工资和价格中，从而进一步推高总体通胀。央行官员的常用工具对降低预期可能作用不大。就连加息影响几何也不完全清楚。根据本刊和YouGov近期的联合民意调查，对于加息会提高还是降低通胀这个问题，选前者的美国人是后者的两倍。

还可以做些什么？历史给出了几个选择。一是发布内容激进或出人意料的公告。比如可以在计划好的会议之外宣布加息，印度央行在5月就是这样做的。欧洲央行曾用这套做法来追求另一个目标：压低政府债券利差，以避免可能的债务危机。2012年，时任欧洲央行行长的马里奥·德拉吉（Mario Draghi）在演讲时即兴承诺要“不惜一切代价”保全欧元。欧洲央行的迈克尔·艾尔曼（Michael Ehrmann）和牛津大学的阿勒娜·沃比茨（Alena Wabitsch）的研究显示，这句话在推特上的非专业人士当中产生了很高的流量，表明他们听进去了。其他研究表明，这句话的高明之处在于它着眼于目的（“保全欧元”），而不是手段（“购买债券”），这对于公众来说更容易理解。欧洲央行之后试图故伎重施，比如召开紧急会议以解决利差扩大的问题。

其他人玩的是长线游戏。1979年至1987年间担任美联储主席的保罗·沃尔克（Paul Volcker）是出了名的通胀“疯子”——经济学家圈子这样称呼那些为降服通胀猛兽宁愿忍受高失业率的人。公众最终明白了他的用意。伦敦政治经济学院（London School of Economics）的乔纳森·哈泽尔

（Jonathon Hazell）最近和他人共同发表的一篇论文认为，在疫情之前，

后沃尔克时期“对长期货币机制的看法转变”被证明在抑制通胀方面比任何其他因素都更重要。英国央行行长安德鲁·贝利（Andrew Bailey）一直试图拥抱自己内在的沃尔克，比如让英国人觉得他更关心通胀而不是他们的工资水平。

| 头号公敌

另一个办法是让政客参与进来。这有潜在的弊端，因为政客经常提倡价格管制等想入非非的抗通胀计划。但他们仍有可能帮上忙。毕竟，37%的美国人认为总统对通胀有“很大”的掌控力，而只有34%的人认为美联储有这种能力。1979年，卡特通过任命沃尔克来表明他是真的重视降低通胀。在英国，撒切尔夫人和她的亲信在价格稳定问题上态度强硬，他们愿意削减政府预算可能为自己的表态提供了支持，代价是冷却了经济。如今在美国，拜登说“对抗通胀”是他的“首要经济任务”（尽管他看起来没那么愿意收紧财政政策）。

公众对央行工作漠不关心，也许是对八九十年代政策制定者的一种间接的恭维。通胀处于低位时，没人需要关心它。这种成功却让现在的政策制定者难以施展拳脚。所以为了让通胀预期回落，他们可能需要尽己所能让人们打起精神，好好听他们讲话。■



Stent technology

How to hide surgical implants from the immune system

Paint them with platelets

Platelets play an essential role in healing. These curious beasts (pictured above), are cell fragments rather than complete cells—though they are still surrounded by cell membranes. Their main job, in collaboration with a protein called fibrin, is to stem the flow of blood from wounds by causing clots. They also encourage the regeneration of damaged tissue.

This sort of activity at wound sites might normally draw the attention of the immune system, but that does not happen because platelets carry special proteins in their membranes which render them invisible to immune surveillance. Now, Wang Yunbing at Sichuan University in China writes in *Matter* that he has developed a way to apply these membranes to medical equipment of the sort destined for installation inside the human body. That may stop the immune system attacking such grafts as foreign objects.

The idea of coating equipment with platelet membranes has been around for a while. Since the relevant proteins were characterised 20 years ago, they have been used on numerous occasions to disguise nanoparticles employed for drug delivery. That involves manipulating the surface electric charges of the nanoparticles to make them sufficiently and uniformly negative in a way which encourages the membrane to fuse with them.

For such small objects, this is reasonably simple. But not for large ones. Manipulating charge uniformly across a wide area is tricky, and no one has yet done it well enough to achieve successful fusion. Dr Wang therefore wondered if it might be possible to entice membranes to fuse to a large surface by manipulating that surface in other ways. Besides being attracted

to negative charges, platelet membranes also spread easily and defect-free over “superhydrophilic” (exceptionally water-loving) surfaces. With this in mind, he tested a superhydrophilic material based on a substance called polydopamine, which he knew from previous work binds to a range of materials including plastics, metals and ceramics. So he gathered a team of colleagues together to fuse it to a metal stent.

Stents are used by heart surgeons to open up blood vessels that have got clogged. They are extremely effective at keeping people alive, but do attract the attention of the immune system, causing inflammation of the tissues around them, which results in scarring. If enough scar tissue forms, that can itself impede blood flow. Worse, it can result in part of the scar breaking off and causing a stroke or pulmonary embolism. Over the past two decades, types of stent have been designed that slowly release anti-inflammatory drugs and so reduce these risks. But success is not guaranteed, and the consequences of failure are severe.

The team coated their experimental stents by dipping them in a solution of dopamine and a substance called sodium periodate. They then charged the coated stent to an appropriate negative voltage and dropped a suspension of “platelet-derived extracellular vesicles” (small bubbles of membrane that platelets can be induced to cough up by appropriate treatment) onto it, before incubating it at 37°C for a couple of hours.

| *Hidden in plain sight*

This done, examination with a microscope indicated that the stent was indeed covered in platelet membrane. But, to be sure the immune-shielding proteins were still there, the team used two special techniques, immunofluorescence and western blotting, to check for their presence.

The acid test, however, was to try out the stents in animals. To that end they picked a group of rabbits and implanted into their abdominal aortas stents

which had no coating, stents coated only in polydopamine, and stents which had also had platelet membranes attached to them. After eight hours, they removed some of the stents and looked for a build-up of inflammatory cells. They left the rest in place, allowed the animals to recover from the surgery, and then let them go about their lives for a month before killing them and collecting their stents for analysis.

As expected, even after eight hours, let alone a month, the uncoated and the polydopamine-coated stents were saturated in cell growth triggered by immune activity. On both occasions, however, the membrane-coated stents were clean.

Translating this preliminary result in rabbits into a clinical application in human beings will be a hard graft, as it were. How long the coating will last remains unknown. And rabbits are not people, so the details of their physiologies are different. But as a start, Dr Wang's work is remarkable, for it opens a whole, new avenue of investigation into the problem of sustaining medical implants. ■



支架技术

如何让外科植入物躲过免疫系统的雷达

给它们涂上血小板【新知】

血小板在愈合中发挥至关重要的作用。这些奇怪的家伙（上图）是细胞碎片而不是完整的细胞——尽管它们仍然被细胞膜包裹。它们的主要工作是和一种叫纤维蛋白的蛋白质合作，通过形成凝块阻止伤口继续流血。它们也促进受损组织的再生。

伤口部位的这种活动照理会引起免疫系统的注意，但事实并非如此，这是因为血小板在其细胞膜中携带的特殊蛋白质使得免疫监测看不到它们。现在，四川大学的王云兵在《物质》（Matter）期刊上发表的论文中写道，他已经研发出一种方法，把这些膜应用到那些要安装到人体内部去的医疗设备上。这或许能防止免疫系统把这些移植物视作异物而发起攻击。

用血小板膜包覆设备的主意已经存在了一段时间。20年前人们发现了那些蛋白质的特点，此后它们就被频繁用作送药纳米粒子的伪装。通过操控这些纳米粒子的表面电荷，使之充分且均匀地呈负电荷，可以促使膜与粒子结合。

在纳米粒子这么小的物体上，这种方法尚算简单。但在大件物体上就不行了。要大范围均匀地操纵电荷很难，到目前为止还没有谁能做得足够好而实现成功的结合。因此，王云兵想知道是否有别的方法可以操纵大块表面，诱使膜与之结合。血小板膜除了会被负电荷吸引外，还会在“超亲水”表面轻松无缝贴合。这让他想到测试一种基于名叫聚多巴胺的物质的超亲水材料，他从过去的研究中了解到这种物质可与塑料、金属和陶瓷等一系列材料结合。他召集了一群同事，把它融合到一个金属支架上。

心脏外科医生用支架撑开阻塞的血管。它们在维持生命方面极其有效，但确实会引起免疫系统的注意，继而造成支架周围组织发炎，形成疤痕。这些疤痕组织若多到一定程度，本身又会阻碍血液流动。更糟的是，疤痕可

能部分脱落而引发中风或肺栓塞。过去20年里，人们设计出了一些会缓慢释放抗炎药物以降低这类风险的支架，但依然无法保证成功，而失败的后果严重。

研究团队把他们的实验支架浸入多巴胺溶液和一种叫做高碘酸钠的物质中，在支架表面形成包覆涂层。然后他们把带涂层的支架充电至适当的负电压，并把一种“血小板衍生的细胞外囊泡”（经适当处理诱导血小板释出的微小球状膜性囊泡）悬浮液滴到支架上，然后在37摄氏度下培养两三个小时。

| 躲在明处

完成以上步骤后，在显微镜下可以看到支架确实已被血小板膜包覆。但是，为确保那些能屏蔽免疫系统的蛋白也还在那里，研究团队运用了免疫荧光和蛋白质印迹这两种专门技术来检查其存在。

然而，真正的考验是在动物身上试验这种支架。为此他们挑选了一些兔子，在它们的腹主动脉中植入不带任何涂层的裸支架、仅带聚多巴胺涂层的支架，以及也带有血小板膜涂层的支架。八小时后，他们移除了其中一些支架并寻找炎症细胞积聚的迹象。他们让其余支架留在原处，让兔子从手术中恢复，再放任它们自由生活一个月，然后杀死它们，收集它们体内的支架来做分析。

正如他们的预期，八小时后，裸支架和聚多巴胺涂层支架的周围就已经充斥着由免疫活动触发的细胞生长，更不用说一个月后了。而血小板膜涂层支架始终都很干净。

要把这种在兔子身上的初步结果转化为在人类身上的临床应用将是一项艰巨的“移植”。涂层能维持多久仍是未知数。而且兔子不是人，两者生理细节不同。但王云兵的研究是一个杰出的开端，因为它为医疗植入设备的维持问题开辟了一条全新的探索路径。■



Schumpeter

In EY's split, fortune may favour the dull

Bean-counters v lion-tamers

In a Monty Python sketch from 1969, the middle-aged Mr Anchovy, played by Michael Palin, wants to give up what he calls the desperately dull world of chartered accountancy in order to become a lion-tamer. His “vocational guidance counsellor”, aka John Cleese, suggests he consider an interim career path—banking, say—while he works towards lion-taming. “No, no, no, no, no,” Mr Anchovy interrupts. “I don’t want to wait. At nine o’clock tomorrow I want to be in there, taming.”

Echoes of Mr Anchovy’s yearnings can be heard in the haste with which EY, one of the Big Four accounting firms, is considering spinning off its fast-growing consultancy practice from the unfashionable audit side of the business. Not only is it a bold move by the standards of book-keeping firms—to the point, says Michael Izza of the Institute of Chartered Accountants in England and Wales, that EY’s three rivals, Deloitte, PWC and KPMG, will be considering their next steps in light of its decision. There is also a hint of Pythonesque farce about it. Such is the excitement that details of a proposed initial public offering (IPO) in 2023 were leaked to the Wall Street Journal, which published them on June 20th. They included the size of the potential bonanza for some of the firm’s 13,000 partners—something EY’s bean-counters of old would much rather have kept under their bowler hats.

The firm insists no final decision has been made. Yet a split would make sense. Regulators worry that consulting services generate conflicts of interest for firms also carrying out statutory audits. After a string of accounting scandals in recent years they are urging the auditors to stand on their own two feet. As for an IPO, that is bound to set consultants’ hearts

rating. But like Mr Anchovy, they should think twice before they leap into the lion's den. In the long run, audit may well be the more prudent bet.

Make no mistake, the advisory practice is the red-blooded side of the business. It accounted for two-thirds of EY's \$4obn in revenues last year. Unshackling much of the tax, consulting, strategy and transactions work from audit would give the consulting arm more room for manoeuvre and free it from a partnership model that smothers quick decision-making. The new advisory firm could raise capital more easily to invest in technology, as well as developing trendy outsourcing businesses such as fully running multinationals' tax affairs. It could bolster its fortunes by offloading niche businesses. (Not that it needs to wait for an IPO to do that: last year PWC sold one that handles global companies' foreign postings to a private-equity firm for \$2.2bn, its biggest divestment in nearly two decades.)

There is an even more enticing precedent. Accenture, which was spun off from Arthur Andersen and then went public a year before the accounting firm collapsed in 2002, has soared in value to \$19obn. EY's consulting arm would not be worth close to that. However, the leaked documents, based on recent market conditions, suggest it could raise \$1obn by selling a 15% stake. The partners who join it would receive 70% of the shares (the remaining 15% would be for lowlier staff).

It is not all upside for the consultants, though. The split would involve a cash payout from the spun-off company to partners remaining in the rump EY, and would cover potential claims against the firm for problems such as those at Wirecard, a failed German payments company, and NMC Health, a collapsed British hospital chain, both of which EY audited. To make the payment, the new firm would reportedly borrow \$17bn—a large sum considering that publicly traded rivals like Accenture and TCS have low debts.

Those are not the only competitors, either. Barriers to entry in consulting are low. Big tech firms such as Microsoft and data-miners such as Palantir may try to muscle into the space. The EY brand may have raised the stature of the consultancy practice, but it will probably be floated with a new name. Like some other consultants, it could fall victim to delusions of grandeur.

That is why, despite being the pedestrian side of the business, audit could be a dark horse. Its shortcomings are well known: lack of trust, conflicts of interest, low pay compared with other professional services, the risk that AI-powered “audit bots” will crawl over its business model. Yet it has some advantages.

For one thing, it remains an entrenched oligopoly. The Big Four audit 99% of firms in the S&P 500 index. Moreover, structural changes are afoot that could benefit it. The first is regulatory. As the Big Four auditors are forced to become more independent, they are raising fees. As pressure mounts to improve audit quality, they will charge more for it. The second change is to their scope. The firms are expecting a lot of new work as regulators force companies to disclose more about their climate impact. Much of this will have to be checked and approved by auditors. One senior accountant talks excitedly about hiring “thousands of eco-warriors”.

If history is any guide, the windfall from the split may favour the auditors, too. Though the partners remaining on the audit side would receive lower payouts than those departing with the consultancy, cash in hand is precious, especially in times of volatile markets. The last time EY split off its consultancy, selling it to Capgemini, a French firm, in 2000, the partners who received cash, not shares, did better. And after that the auditors simply rebuilt the consulting side of the business. Even now they plan to retain elements of advisory work, such as parts of the tax practice. These could again be reconstructed into something bigger.

| *Ants in the pants*

Those with long memories, such as the older partners, will know all this. Many of the more junior ones may find themselves lured by the eat-what-you-kill excitement of consultancy. But if they ignore history, they should not ignore comedy. Mr Anchovy never did become a lion-tamer. What he thought was a lion was instead an anteater. Shown a photo of a real lion, he passed out. ■



熊彼特

安永拆分安者胜

账房先生对阵驯狮高手

在巨蟒剧团（Monty Python）1969年的一出滑稽短剧中，由迈克尔·佩林（Michael Palin）扮演的中年特许会计师安乔维（Anchovy）想要放弃他眼中枯燥透顶的职业生涯，去做一名驯狮师。由约翰·克里斯（John Cleese）扮演的“职业顾问”建议他在成为驯狮师之前考虑一份过渡性的工作，比如去银行。“不，不，不，不，不，”安乔维打断了他，“我等不及了。明天上午9点我就要开始驯狮子。”

在安永公司眼下的动静中，你听到了安乔维热切的渴望。这家四大会计师事务所之一正急不可耐地想要将自己快速增长的咨询业务从不再时髦的审计业务中剥离出去。英格兰及威尔士特许会计师协会（Institute of Chartered Accountants in England and Wales）的迈克尔·伊泽（Michael Izza）表示，这是一个大胆的举动，不仅仅是以会计事务所的标准来衡量（以至于德勤、普华永道和毕马威这三大竞争对手也会根据这项决策考虑自己的下一步）。它还带有点巨蟒滑稽剧的味道。有人实在难抑兴奋，把它计划在2023年IPO上市的细节泄露给了《华尔街日报》，该报于6月20日将之公之于众。其中包括安永1.3万名合伙人中的一些人可能会发多大一笔财——换了安永昔日的审计合伙人肯定会宁可这样的信息秘而不宣。

安永坚称尚未做出最终决定。不过，拆分是有道理的。监管机构担心咨询服务会在同时从事法定审计的公司内产生利益冲突。在经历了近年来一连串的会计丑闻后，它们正在敦促审计机构保持自身的独立性。至于IPO，肯定会让咨询部门的人心跳加速。但就像安乔维一样，他们在踏入狮笼前应该三思。从长远来看，做审计很可能是更稳妥的选择。

毫无疑问，咨询是安永业务中更有活力的部分。安永去年400亿美元的营收有三分之二来自咨询。将税务、咨询、战略和交易等的大部分工作从审计中剥离出去，会让咨询部门拥有更多的操作空间，并让它摆脱阻碍快速

决策的合伙人模式。新成立的咨询公司不仅可以发展时髦的外包业务，比如全面管理跨国公司的税务，还可以更轻易地筹集资金用于技术投资。它还可以通过转卖利基业务增加自己的财富。（并不是说它需要等到IPO才能这么做：去年普华永道就以22亿美元的价格将其为跨国公司提供全球派遣咨询的小众业务出售给了一家私募股权公司，这是该公司近20年来最大的一次业务剥离。）

还有比这更诱人的先例。2001年，埃森哲（Accenture）从安达信（Arthur Andersen）剥离出来并上市，一年后安达信倒闭，而埃森哲的市值飙升到了1900亿美元。虽然安永咨询部门的价值将与之相去甚远，但泄露给《华尔街日报》的文件显示，根据最近的市场状况，该部门可以通过出售15%的股份筹集到100亿美元。加入咨询部门的合伙人将获得70%的股份（剩下的15%会分配给较低级别的员工）。

不过，对咨询顾问们来说也不全是好事。因为分家后，拆分出来的新公司要向留在安永审计部门的合伙人支付现金，还会承担一些可能针对安永提出的索赔，比如涉及破产的德国支付公司Wirecard和倒闭的英国连锁医院NMC Health的问题，这两家公司的审计都是由安永完成的。据报道，为了支付这些款项，新公司将借入170亿美元——考虑到埃森哲和塔塔咨询服务（TCS）等上市竞争对手的负债都较低，这是很大一笔钱。

而且安永的竞争对手也不止这两家。进入咨询业的门槛不高。微软等大型科技公司和Palantir等数据挖掘公司可能也会试图挤进来。安永的品牌可能提高了它咨询业务的声望，但它上市时可能会有个新名字。而和另一些咨询公司一样，它可能会栽在妄自尊大上。

这就是为什么尽管审计只是安永一个乏味无趣的部门，却可能是一匹黑马。它的缺点众所周知：信任缺失、利益冲突、薪酬低于其他专业服务，以及人工智能驱动的“审计机器人”给这一业务模式带来的风险等。不过它也有一些优势。

首先，它仍然是根深蒂固的寡头卖方垄断。四大承揽了99%的标普500指

数公司的审计。此外，各种可能使之受益的结构性变革正在进行之中。首先是监管方面。随着四大被迫变得更加独立，它们正在提高收费。提高审计质量的压力越来越大，它们也会相应收取更高的费用。第二个变化是业务范围。它们预计会迎来大量的新工作，因为监管机构正迫使各家公司对自己的气候影响做更多信息披露。其中大部分都必须经过审计人员的核查和批准。一位高级会计师兴奋地谈到要雇用“成千上万个生态卫士”。

如果历史可以引以为鉴的话，那么拆分带来的意外之财可能也会更有利于审计人员。尽管留在审计部门的合伙人获得的财富会少于随咨询公司而离开的合伙人，但现金在手才是王道，尤其是在市场动荡之时。上次安永在2000年剥离了它的咨询部门，把它卖给了法国公司凯捷（Capgemini），那些分得现金而非股票的合伙人得益更多。并且在那之后，审计人员又直接重建了咨询业务。即使是现在，他们也计划保留少量的咨询工作，比如部分税务咨询。这些业务可以重新做大。

| 兴奋难安

那些记性好的人，比如年长的合伙人，会对这一切心知肚明。许多资历较浅的人可能会觉得自己被咨询公司那种“论功行赏”的兴奋感所吸引。但即使他们无视历史，也不应该无视滑稽剧。安乔维从没有真正成为驯狮师。他一直都把食蚁兽当成了狮子。在看了一张真狮子的照片后，他晕了过去。■



O for the wings of an albatross

Borrowing tricks from birds may result in smoother flights

Wings that morph and flap will also save money

While chatting to a customer in the family bicycle shop in Dayton, Ohio, Wilbur Wright was idly twisting a piece of cardboard that had once contained an inner tube, when he came up with an idea. The “semi-rigid” way in which the cardboard could be deformed yet still retain its stiffness might, he considered, provide an answer to a little problem he was working on with his brother Orville: how to design a wing for a heavier-than-air flying machine.

The Wright brothers knew, from ornithological observations, that if a wing on one side of a bird’s body meets the oncoming flow of air at a greater angle than the opposite wing does, then that wing will rise. An aircraft wing which could be made to twist like this would help a pilot bank and turn. Using mechanical gears and levers to rotate an entire fully-rigid wing to do that would make the plane too heavy. A semi-rigid wing, however, could be warped into different angles using a lightweight series of wires and pulleys. Which is how, on December 17th 1903, the brothers achieved the first controlled and sustained flight of a powered aircraft.

The Wright brothers called their system wing-warping. But it did not last. Within a few years, aviators began adopting a more reliable form of control that fitted hinged ailerons and flaps to the trailing edges of wings, and in 1915 Orville (Wilbur having died three years earlier) conceded, and followed suit. But, in a slightly different guise, wing-warping is now back. And not only that. In their efforts to make wings more efficient, which saves fuel, aerospace engineers are also looking for inspiration from birds’ wings in another way, by borrowing a trick from the most accomplished long-range flyer of them all, the albatross.

Airbus, a giant European producer of passenger jets, recently completed a series of tests on new forms of wing control using a model in a wind tunnel at Filton, near Bristol, in south-western Britain. As a result, the company is now fitting these systems to a specially built wing that will, as an experiment, be used to replace one of those on a Cessna Citation business jet. This aircraft will then test the new designs in real flying conditions.

One feature of the eXtra Performance Wing, as it is called, is that instead of having moving surfaces attached to the wing with hinges, mechanical actuators will change the shape of a semi-flexible surface on the trailing edge. These “morphing” surfaces will be multifunctional, meaning that by moving them up or down they can be used either as ailerons (which allow the pilot to bank and turn a plane) or as flaps (which provide extra lift). Pop-up spoilers that emerge from the top surface of the wing will conversely reduce lift, and help slow the aircraft during landing.

The wing itself will have a high aspect ratio—in other words, a long, thin shape that helps (at the expense of manoeuvrability) to reduce aerodynamic drag. The problem with long wingspans on passenger aircraft, however, is that a plane might not fit into the gates at airports. Hence the idea is to fold the wing tips up once the plane is on the ground.

| *Hinge and bracket*

Folding wings are not a new idea. Naval aircraft, which already have a low aspect ratio, have long folded their wings in order to fit into the cramped confines of aircraft-carriers. And Boeing, an American firm that is Airbus’s chief rival, is developing a new version of its 777 aircraft, the 777X, which will also fold its wing tips. (When unfolded, these will add 3.4 metres to the length of each wing.)

Airbus, though, is giving this idea a new twist, by borrowing a trick from the albatross. During long flights, an albatross locks the elbow joints of its

extended wings to make them rigid. Thus fixed, they work much like those of a glider (a type of aircraft that has among the highest aspect ratios of all). The bird unlocks its wings and flaps them when it needs to manoeuvre or cope with gusty conditions.

The Airbus wing tips will do something similar. When unlocked in flight, they will be capable of flapping freely up and down during gusts of wind or periods of turbulence. In this way, says Oliver Family, who leads the project, aerodynamic loads on the wing will be reduced, allowing the wing to be made lighter—which, in turn, improves fuel economy. The flapping tips will also help provide a smoother flight. In addition, the project will explore the use of sensors that could spot gusty conditions ahead of the plane and prepare the wing tips for flapping.

The converted Citation, which is due to fly by 2024, will be operated remotely by a pilot on the ground. This is a safety measure, because Airbus intends to use its test flights to push the aircraft to its limits. The company says it is not committed to using these new systems in future aircraft. But if one or other of them proves its worth, passengers gazing idly out the window of future airliners are likely to see the wings on their aircraft moving in unusual ways. ■



赐我信天翁之翼

借鉴鸟类的技巧可能会让飞行更平稳

会变形和摆动的机翼还能省钱【新知】

一天，威尔伯·莱特（Wilbur Wright）在俄亥俄州代顿市（Dayton）自家的自行车铺子里和顾客聊着天，随手摆弄着一个内胎包装纸盒，突然间有了个主意。纸板可以弯折变形，但仍保持硬度，他认为这种“半刚性”的特点也许能解决他和弟弟奥维尔（Orville）正在琢磨的一个小问题：如何给重于空气的飞行器设计机翼。

莱特兄弟观察鸟类发现，在遇到迎面而来的气流时，如果鸟调节身体，让一侧翅膀的迎风角度比对侧翅膀更大，那个翅膀就会升起。如果机翼可以像鸟的翅膀一样扭转，就能帮助飞行员倾斜机身转弯。用机械齿轮和杠杆来旋转纯刚性的机翼会让飞机太重。而半刚性机翼可以通过更轻量的钢丝和滑轮弯折成不同的角度。1903年12月17日，兄弟俩就这样实现了动力飞机首次完全受控的持续飞行。

莱特兄弟把他们的系统称为翘曲机翼。但它并没有被长期沿用下去。几年后，飞行员开始采用一种更可靠的控制系统——在机翼后缘铰接上副翼和襟翼。1915年，奥维尔（威尔伯已于三年前去世）承认这种设计更好，也开始效仿。但是，翘曲机翼的设计现在又东山再起，只是形式稍有不同。还不止如此。航空航天工程师在努力提高机翼效率以节省燃料的过程中，也以另一种方式从鸟类的翅膀中寻找灵感——他们借鉴了长途飞行的佼佼者信天翁的一项技巧。

在英国西南部城市布里斯托尔（Bristol）附近的菲尔顿（Filton），欧洲大型客机生产商空客公司近期在一个风洞中完成了用模型测试一系列新型机翼控制系统。它目前正尝试将这些控制系统安装到一个特制机翼上，替换掉一架塞斯纳（Cessna）Citation公务机上的机翼。这架飞机将在真实飞行条件下测试新设计。

这个“超高性能机翼”（eXtra Performance Wing）有一个特点，就是不使用铰链来把可动表面连接到机翼上，而是由机械致动器改变机翼后缘的半柔性表面的形状。这些“可变形”表面将是多功能的，向上或向下移动时可用作副翼（让飞行员能够倾斜机身转向）或襟翼（提供额外的升力）。从机翼上表面展开的弹出式扰流板反过来会降低升力，帮助飞机在着陆时减速。

这个机翼本身将具有高展弦比，也就是形状细长，这有助于减少气动阻力（牺牲了部分可操纵性）。但客机的长翼展会带来一个问题：飞机可能没法接驳登机口。对此空客的想法是当飞机在地面上时把翼尖向上折叠。

| 铰链和支架

折叠机翼的想法并不新鲜。海军飞机的展弦比原本就低，为了适配航空母舰上的狭窄空间还一直折叠机翼。空客的主要竞争对手美国波音公司正在开发其777飞机的新型号777X，也将能折叠翼尖。（展开后，单侧翼展将增加3.4米。）

不过，空客借鉴信天翁的技巧，给这个想法带来了新意。在长途飞行中，信天翁展开双翅后会锁定翼部关节，使之不易弯曲。固定之后，其双翼的工作原理与滑翔机（这种飞机的展弦比在最高之列）很相似。当它需要调整姿态或应对阵风时，信天翁会解锁关节，拍打双翅。

空客的翼尖将具有类似的功能。在飞行中解锁后，它们将能够在出现阵风或湍流时自如地上下摆动。领导该项目的奥利弗·法米利（Oliver Family）表示，通过这种方式，机翼上的气动载荷将减少，机翼可以变得更轻，从而提高燃油经济性。能摆动的翼尖也将有助让飞行更平稳。此外，该项目将探索利用传感器，它们可发现飞机前方阵风状况，好让翼尖做好拍打的准备。

改装后的Citation将于2024年升空，由一名地面飞行员远程操控。这是一项安全措施，因为空客打算在试飞中测试飞机的极限。该公司表示并未决定在未来的飞机上使用这些新的机翼系统。但如果其中哪个系统证明了其

价值，那么未来飞机上的乘客在无意间眺望窗外时，很可能就会看到机翼在做奇妙的摆动。 ■



Blockchain reaction

Three mechanisms for crypto contagion

How to make sense of bitcoin's plight

This year's Juneteenth holiday in America gave crypto buffs little time to reflect or rejoice. On June 18th bitcoin reached a low of \$17,600—its first tumble below \$20,000 since 2020—before recovering a little the next day. The sell-off sparked over \$1bn in liquidations, as traders who had borrowed money to make big bets failed to post more collateral.

Overall, bitcoin is about 70% below its peak in November; ether, another cryptocurrency, is down by around 80%. As prices have fallen, cracks have appeared in the crypto infrastructure. Babel Finance and Celsius, two crypto lenders, have paused withdrawals after struggling to meet redemptions; their rivals have trimmed their balance-sheets, causing a credit crunch. Third Arrow, a crypto hedge fund, has failed to meet margin calls, and Hoo, an exchange, has halted transactions.

The risk of a fresh downward spiral remains. Traders that were not wiped out have managed to post more collateral with decentralised-finance (DeFi) lenders; the level at which margin calls are triggered briefly dipped. But data from Parsec Finance, an app, suggest that the threshold has risen again to nearly \$900 a coin for ether, from \$700 on June 20th (at the time of writing, the price of ether was \$1,100). Recent events have also shown how three weaknesses in crypto can amplify trouble: fuzzy valuations, incestuous relationships and the lack of a liquidity backstop.

Start with valuations. Some of the most commonly traded crypto tokens are complex products such as derivatives and “tokens” issued by DeFi platforms, for which there are no established valuation models. The lack of an anchor means trust in pricing can vanish in a jiffy; the effect is

magnified on weekends, when trading volumes are thinner. Problems in parts of the crypto market can end up rippling outwards, not least to bitcoin, the benchmark for the entire universe.

A second channel of contagion comes from the high degree of interconnectedness between DeFi platforms. This is partly the result of intensifying competition. The amount of money invested in DeFi, after a period of explosive growth, has fallen over the past year. As crypto lenders have vied to attract a shrinking pile of dollars, they have promised ever-higher yields to depositors, which, in turn, has led them to invest users' funds in riskier projects—typically other lending and yield-generating platforms. When the price of one asset falls, the effects cascade through the system.

Celsius is a case in point. In December it claimed to have \$24bn in crypto assets under management, which it had lured by offering yields to depositors of as much as 18%. To achieve those returns, it made loans to marketmakers, hedge funds and DeFi projects. When prices sank, however, so did the value of those assets. Some, such as the \$400m Celsius held in “staked ether”, a derivative, proved illiquid. That left the firm unable to meet growing demand for withdrawals. When Celsius eventually froze funds on June 14th, bitcoin sank by 25%, partly on fears of contagion.

These goings-on revealed a third weakness: the lack of a liquidity backstop to prevent a free-fall in asset prices. In mainstream finance, regulators provide a safety-net. But no institution exists to mop up stressed crypto assets of systemic importance (at least to the crypto system), such as stablecoins, or to bail out important firms. Deposits with crypto lenders are not insured. In conventional finance, such fail-safes reduce the risk of panic-selling when prices tumble.

Were bitcoin to drop below \$15,000, liquidations could accelerate so much

that posting enough collateral or raising funds to stop the fall may become hard, say Monsur Hussain and Alastair Sewell of Fitch, a rating agency. But it would probably take a trigger for that to happen: a huge hack at an exchange, say, or a big economic surprise. And time seems to be on crypto's side. Crypto platforms, and the risks they take with their assets, may soon come under regulatory scrutiny. Some stablecoins are trying to build sounder reserves: Tether, the issuer of the world's largest such coin, has said it plans to replace its holdings of commercial paper with safer Treasuries. Some of the makings of a frosty crypto winter, though, are still in place. ■



区块链式反应

“加密传染”的三个机制

如何理解比特币的困境

今年的美国六月节，加密货币爱好者无暇反思也无心庆祝。6月18日，比特币跌至17,600美元的低点——自2020年以来首次跌破2万美元——翌日略有回升。由于借钱豪赌的交易者无法提供更多抵押品，此次抛售引发了逾10亿美元的平仓。

总体而言，比特币从去年11月的峰值回落了约70%，另一种加密货币以太币（Ether）下跌了约80%。随着价格下跌，加密货币的基础设施裂痕显现。Babel Finance和Celsius这两家加密货币借贷公司由于无力满足赎回需求而暂停提款功能；它们的竞争对手缩减了资产负债表，造成信贷紧缩。加密货币对冲基金Third Arrow未能满足追加保证金的要求；交易所Hoo暂停交易。

新一轮螺旋式下跌的风险依然存在。没有爆仓的交易者已经设法通过DeFi（去中心化金融）贷款机构提供了更多抵押品；追加保证金的触发门槛短暂降低。但应用Parsec Finance的数据显示，以太币的触发门槛从6月20日的700美元再次升至近900美元（撰写本文时，以太币的价格为1100美元）。最近的事件也表明加密货币的三个弱点会扩大麻烦，包括模糊不清的估值、过于密切的内部关联和缺乏流动性保底。

首先是估值。一些交易最活跃的加密代币是复杂的产品，例如衍生品和DeFi平台发行的“代币”，并没有既定的估值模型。由于缺乏价值锚定，对定价的信任可能顷刻消失；周末的交易量较低，会让这种影响进一步放大。加密货币市场的局部问题可能会向外扩散，尤其是可能会影响到整个加密宇宙的基准——比特币。

第二个传染渠道源自DeFi平台之间的高度关联性。这在一定程度上是竞争加剧的结果。在经历了一段爆炸性增长之后，投资DeFi的资金在过去一年

里已经减少。随着加密货币借贷机构竞相吸引逐渐稀缺的资金，它们向储户承诺的收益率越来越高，反过来又导致它们将用户资金投资于风险更高的项目——通常是其他放贷和产生收益的平台。一种资产的价格下跌时，会在整个系统中引发一连串反应。

Celsius就是个典型例子。去年12月，该公司声称管理着240亿美元的加密货币资产，这是它通过向储户提供高达18%的收益率吸引来的。为了实现这样的回报率，它向做市商、对冲基金和DeFi项目提供贷款。然而，当价格闪崩，这些资产的价值也随之下跌。其中一些资产还不具备流动性，例如Celsius持有的4亿美元的衍生品“质押以太币”。这使得该公司无法满足不断增长的提款需求。Celsius最终在6月14日冻结资金，比特币也应声下挫25%，一定程度上是因为人们担心危机蔓延。

这些现象又暴露了第三个弱点：缺乏某种流动性保底来防止资产价格发生自由落体式下跌。在主流金融领域，监管机构提供了一张安全网。但是目前不存在任何机构能够为承压的（至少对加密货币体系而言）具系统重要性的加密资产（如稳定币）收拾残局，或救助重要的公司。在加密货币放贷平台的存款不受保险保障。而在传统金融领域，当价格暴跌时，这类安全措施降低了恐慌性抛售的风险。

评级机构惠誉（Fitch）的曼苏尔·侯赛因（Monsur Hussain）和阿拉斯泰尔·苏埃爾（Alastair Sewell）表示，如果比特币跌破1.5万美元，平仓行为可能急剧加速，以至于难以提供足够的抵押品或筹集资金来阻止下跌。但发生这种情况很可能需要一个导火索：例如交易所遭遇大规模黑客攻击，或者发生重大经济意外。而加密货币尚有时间等待状况改善。监管机构可能很快将对加密货币平台及其资产所承担的风险展开审查。一些稳定币正试图建立更健全的储备：世界上最大的稳定币发行机构Tether表示，计划用更安全的美国国债来取代其持有的商业票据。不过，造成加密货币寒冬的一些因素仍未消除。■



Doctor Google will see you now

Alphabet is spending billions to become a force in health care

Can it finally shake up the stodgy multi-trillion-dollar industry?

Rich countries pour heart-stopping amounts of money into health care. Advanced economies typically spend about 10% of GDP on keeping their citizens in good nick, a share that is rising as populations age. America's labyrinthine health-industrial complex consumes 17% of GDP, equivalent to \$3.6trn a year. The American system's heft and inertia, perpetuated by the drugmakers, pharmacies, insurers, hospitals and others that benefit from it, have long protected it from disruption. Its size and stodginess also explain why it is being covetously eyed by big tech. Few other industries offer a potential market large enough to move the needle for the trillion-dollar technology titans.

America's five tech behemoths have spent billions on various health-care bets. Some of their earlier health-related investments are starting to pay off. Amazon runs an online pharmacy and its telemedicine services reach just about everywhere in America that its packages do, which is to say most of it. Apple's smartwatch keeps accruing new health features, most recently a drug-tracking one. Meta scrapped its own smartwatch plans earlier this year but offers fitness-related fun through its Oculus virtual-reality goggles. Microsoft keeps expanding its list of health-related cloud-computing offerings (as is Amazon, through AWS, its cloud unit).

Yet it is Alphabet, Google's corporate parent, whose health-care ambitions are the most vaulting. Between 2019 and 2021 Alphabet's venture-capital arms, Google Ventures and Gradient Ventures, and its private-equity unit, CapitalG, made about 100 deals, a quarter of Alphabet's combined total, in life sciences and health care. So far this year it has injected \$1.7bn into futuristic health ideas, according to CB Insights, a data provider, leaving its

fellow tech giants, which have invested around \$100m all told, in the dust (see chart on next page). Alphabet is the fifth-highest-ranking business in the Nature Index, which measures the impact of scientific papers, in the area of life sciences, behind four giant drugmakers and 20 spots ahead of Microsoft, the only other tech giant in the running. The company has hired former health regulators to help it navigate America's health-care bureaucracy.

Alphabet's approach to innovation—throw lots of money at lots of projects—has served it well in some other businesses beyond its core search engine. It has given rise to clever products, from Gmail and Google Docs to the Android mobile operating system and Google Maps, which support people's digital lives. Alphabet thinks that some of its health offerings will become as central to their physical existence. Is that an accurate prognosis?

Alphabet has dabbled in health care since 2008, when Google (as it was then known) introduced a service that allowed users to compile their health records in one place. That project was wound up in 2012, resurfaced in 2018 as Google Health, which included Google's other health ventures, and was again dismantled last year. Today Alphabet's health adventures can be divided into four broad categories. These are, in rough order of ambition: wearables, health records, health-related artificial intelligence (AI) and the ultimate challenge of extending human longevity.

Google threw itself into the wearables business in 2019 with the \$2.1bn acquisition of Fitbit. That firm's popular fitness tracker has been counting steps and other exertions on around 100m wrists. It has come a long way since the Nintendo Wii motion-detecting game console that inspired Fitbit's founders. A new feature—a sensor which monitors changes in the heart rate for irregularities that can lead to strokes and heart failure—has just been approved by America's Food and Drug Administration (FDA).

Google is also trying to boost the health-care potential of its other devices. To help it along, it has enlisted Bakul Patel, a former official tasked with creating the regulatory classification of “software as a medical device” at the FDA.

The FDA’s stamp of approval for the Fitbit sensor is a big deal. It should make it easier to get a similar thumbs-up for Google’s higher-end Pixel Watch, which uses a lot of the same technology and is due out this autumn, as well as other gadgets. For example, the camera on its Pixel phones can be used to detect respiration and heart rates by tracking the subtle colour difference brought about by the fact that blood with fresh oxygen in it is slightly brighter. Google’s Nest smart-thermostat-turned-home-assistant can listen to snoring to assess your sleep.

As significant, if not more, is that Google considered the regulatory go-ahead worth getting. It signals that the company intends its products to be more than fun consumer gadgets, actually able to influence the practice of medicine.

Google is also giving health records another whirl. The new initiative, called Care Studio, is aimed at doctors rather than patients. Google’s earlier efforts in this area were derailed in part by hospitals’ sluggishness in digitising their patient information. That problem has mostly gone away but another has emerged, says Karen DeSalvo, Google’s health chief—the inability of different providers’ records to talk to each other. Dr DeSalvo has been vocal about the need for greater interoperability since her days in the Obama administration, where she was in charge of co-ordinating American health-information technology. Until that happens, Care Studio is meant to act as both translator and repository (which is, naturally, searchable).

| *Place your Alpha bets*

Alphabet’s AI projects are also beginning to produce results. Starting in

2016 DeepMind, a British firm bought by Google in 2014, used data from Britain's National Health Service (NHS) to create diagnostic tools, in one case training an AI algorithm to detect retinal diseases. (DeepMind's co-founder sits on the board of The Economist's parent company.) It made headlines last year with AlphaFold, a groundbreaking piece of software that can predict the structure of proteins, which is responsible for many of the complex molecules' characteristics. Alphabet has also launched another subsidiary, Isomorphic Labs, which will be run by DeepMind's boss and use machine learning to build on AlphaFold to accelerate (and cheapen) drug discovery.

The most out-there part of Alphabet's health portfolio is an effort to slow the ageing process—or stop it altogether. The idea is that ageing should be viewed not as an immutable aspect of life but as a condition that can be managed and treated, or a problem that can be solved with the right technology. To that end, one of Alphabet's life-sciences subsidiaries, Calico, is looking into age-related diseases. Last year its \$2.5bn partnership with firms including AbbVie, a big drug firm, was extended until 2030. Another Alphabet subsidiary, Verily, is working with L'Oréal, a French beauty giant, to better understand how ageing affects the biology of the skin—and in the process create better skincare.

Inspiring stuff, to be sure. But obstacles remain. Some are technical. The NHS data proved hard for DeepMind's AI to digest. The firm's AI assistant for doctors, called Streams, is being discontinued. Still, given the strides being made in machine learning, it may be only a matter of time before something like Streams is resuscitated.

Other hurdles may be harder to overcome. Trustbusters are increasingly wary of letting through deals that might be seen as stifling nascent rivals. In Europe competition authorities have forbidden Fitbit (but not the Pixel watch) from favouring Google's own phones and operating system, or from

using user data to sell advertising. Governments also fret about privacy breaches, which are more sensitive still when it comes to medical information. Plaintiffs filed a class-action lawsuit in May against DeepMind for misuse of NHS patient data. DeepMind has not made a public statement on the case.

Last, good ideas are not the same things as a good business. The wearables market is highly competitive. So, increasingly, is the one for electronic health records. Google's reputation for technical brilliance has not exactly made Care Studio into an overnight success; the system is reportedly used by just 200 or so clinicians. Verily, which besides solving ageing also offers various diagnostics, signed \$50m-worth of contracts for covid-19 testing during the pandemic, a tidy sum but chump change next to Alphabet's total annual revenues of nearly \$260bn. DeepMind as a whole reportedly turned a profit for the first time in 2020 (seemingly from selling services back to the rest of Alphabet) but it gives away its flagship health product, AlphaFold, for nothing. Calico could be years away from generating real revenues, let alone profits.

These are open-ended wagers that a company of Alphabet's size can absorb with relative ease. In the next decade the challenge will be to show they can graduate from being experiments and vanity projects to something transformative for the firm—and for Americans' health. ■



谷歌医生来给您看诊

Alphabet猛砸钱，要成为医疗新势力

它能撼动这个万亿美元的行业吗？

富裕国家在医疗方面的投入之高令人心惊。通常发达经济体会把约10%的GDP用于公民医疗保健，而随着人口日益老龄化，该比例正不断上升。美国那迷宫般的医疗复合体每年消耗17%的GDP——差不多3.6万亿美元。长期以来，在制药商、药房、保险公司、医院及其他利益方的维护下，美国的医疗系统形成了庞大的影响力和惯性，保护其不被颠覆。它的规模和顽固不化也正是大科技公司对它心生觊觎的原因。很少其他行业有足够大的潜在市场，值得这些市值万亿美元的科技巨头采取行动。

美国五家科技巨头在各种医疗项目上的押注以数十亿美元计。它们的一些早期医疗相关投资开始显现成果。亚马逊经营一个线上药房，其远程医疗服务几乎覆盖了亚马逊包裹所能到达的所有地方，也就是覆盖了美国大部分地区。苹果的智能手表不断添加健康管理功能，最新一个功能是药物追踪。Meta今年早前终止了自己的智能手表项目，但通过其Oculus虚拟现实眼镜提供健身类娱乐。微软不断增加健康方面的云计算产品（亚马逊的云计算部门AWS也是如此）。

不过在医疗方面最雄心勃勃的是谷歌的母公司Alphabet。从2019年到2021年，Alphabet的风险投资部门谷歌风投（Google Ventures）、梯度风投（Gradient Ventures）及私募股权投资部门CapitalG在生命科学和医疗保健领域达成了约100笔交易，占Alphabet交易总数的四分之一。数据供应商CB Insights的数字显示，今年迄今，Alphabet已经向未来派健康创意注资17亿美元，相比总共才投资约一亿美元的其他科技巨头可谓一骑绝尘（见图表）。在评估科研论文影响力的“自然指数”（Nature Index）榜单中，Alphabet在生命科学领域排名第五，仅次于四家制药巨头，比榜单中仅有的另一家科技巨头微软高出20位。Alphabet还聘请了前医疗监管官员来帮助它应付美国医疗体系中的繁文缛节。

Alphabet“广撒网，猛砸钱”的创新方式在其核心搜索引擎业务之外的另一些业务上成效颇佳。由此催生了从Gmail和谷歌文档，到安卓操作系统和谷歌地图等支持人们数字生活的智能产品。Alphabet认为它的一些健康类产品将在人们的肉身存活中扮演同样核心的角色。这预想准确吗？

Alphabet自2008年开始涉足医疗领域，当时还叫谷歌的它推出了电子病历服务，用户可在线集中存储自己的医疗记录。该项目于2012年终止，在2018年以“谷歌健康”的名字再次推出，把谷歌的其他健康项目也纳入进来，但去年再度被拆解。今天，Alphabet的医疗探险可分为四大类，按目标从低到高大致是：可穿戴设备、电子病历、健康相关AI，以及延长人类寿命的终极挑战。

谷歌在2019年以21亿美元收购Fitbit，进驻穿戴设备业务。至今约有一亿人手腕上戴过Fitbit热销的运动跟踪手环，记录步数和其他运动。Fitbit的创始人最早是受任天堂Wii体感游戏机的启发，之后这些手环有了长足的改进。Fitbit手环的一项新功能最近刚获得美国食品药品监督管理局（FDA）批准，可以通过传感器监测可能导致中风和心衰的心率不齐。谷歌也在努力提高旗下其他设备的医用潜力。为此它把巴库尔·帕特尔（Bakul Patel）招致麾下，这位前FDA官员曾负责建立“医疗器械软件”监管类别。

FDA批准Fitbit的这个传感器是件大事。谷歌将于今年秋天推出的高端Pixel手表运用了许多同类技术，应该会因此更易通过监管审批，其他设备也是如此。例如，谷歌Pixel手机上的摄像头可以通过跟踪血液颜色的细微差别来检测呼吸和心率，因为含新鲜氧气的血液会略微鲜艳一些。谷歌从智能温控器演变而来的Nest家居助手可以根据鼾声评估睡眠质量。

谷歌认为值得争取监管部门的批准，这一点同样意义重大。这表明这家公司希望其产品不止是有趣的消费电子产品，还能切实影响医学实践。

谷歌也再度试水电子病历。这个名为Care Studio的新计划面向医生而非病人。谷歌在这一领域的早期努力之所以付诸东流，原因之一是医院在患者信息数字化方面行动迟缓。这个问题现在基本已不复存在，但又出现了另

一个问题——不同提供方的电子病历无法互通，谷歌的健康业务负责人凯伦·德萨尔沃（Karen DeSalvo）说。她在奥巴马政府里负责协调美国卫生信息技术时就开始大力呼吁提升医疗信息互通。在实现这一目标前，Care Studio既充当“翻译”，也是数据库（它自然是可搜索的）。

| 押下阿尔法赌注

Alphabet的AI项目也开始取得成果。谷歌在2014年收购的英国公司DeepMind从2016年开始利用英国国家医疗服务体系（NHS）的数据来创建诊断工具，例如训练AI算法检测视网膜疾病。（DeepMind的联合创始人是《经济学人》母公司的董事。）去年，该公司凭AlphaFold登上头条新闻，这是一款开创性的软件，可以预测决定复杂分子众多特性的蛋白质结构。Alphabet还成立了另一家子公司Isomorphic Labs，由DeepMind的老板执掌，该公司将在AlphaFold的基础上利用机器学习加速新药研发并降低成本。

Alphabet的健康投资组合中最前卫的是一个想要延缓或完全阻止衰老的项目。其理念是不应把衰老看作人生的必然阶段，而应该把它看作可以管理治疗的病症或是可以使用对的技术来解决的问题。为此，Alphabet的生命科学子公司Calico正在研究与衰老有关的疾病。去年，该公司与大型制药商艾伯维（AbbVie）等公司的25亿美元合作项目延长至2030年。Alphabet的另一家子公司Verily正与法国美妆巨头欧莱雅合作，深入探究衰老如何影响皮肤的生物机制，同时研发更好的护肤品。

这无疑鼓舞人心。但仍存在障碍。有些是技术性的。事实证明，DeepMind的AI难以消化NHS的数据。该公司名为Streams的AI医生助手即将停用。但考虑机器学习领域正在大步迈进，类似Streams的工具再次启用也许只是时间问题。

其他障碍可能更难克服。反垄断机构在审批并购方面越发谨慎，生怕可能扼杀新生对手。在欧洲，竞争管理机构禁止Fitbit（但不包括Pixel手表）偏袒谷歌自己的手机和操作系统，或是利用用户数据销售广告。各国政府还担心隐私泄露，这在医疗信息上更为敏感。5月，DeepMind遭遇集体诉

讼，被指控滥用NHS病人数据。DeepMind至今未就此做公开声明。

最后，好主意和好生意不是一回事。可穿戴设备市场竞争激烈。电子病历市场的竞争也日趋激烈。谷歌在技术上的盛誉并没能让Care Studio一夜成名——据称只有约200名临床医生在使用该系统。在研究衰老之外还开发各种诊断工具的Verily在疫情期间签订了5000万美元的新冠检测合同，虽然数目不小，但相比Alphabet总计近2600亿美元的年收入还是不值一提。据报道，DeepMind在2020年首次实现整体盈利（似乎是通过把服务卖回给Alphabet其他部门），但它的旗舰健康产品AlphaFold是开源的。Calico要真正获得收入可能还要很多年，更别说盈利了。

这些开放式押注是体量如Alphabet这样的公司可以相对轻松吸收的。未来十年里的挑战将是让它们不再止步于实验项目或面子工程，而能为这家公司——以及美国人的健康——带来某种变革。 ■



Schumpeter

Amazon has a rest-of-the-world problem

The Everything Store now has too much of everything

As every wartime quartermaster knows, it is only when things go really wrong that you get noticed—or shot. The same is true in the logistics business. That is why it made news recently that Dave Clark, Amazon's former logistician-in-chief, left the Seattle-based online giant to become CEO of Flexport, a shipping-software company. His departure comes just as Amazon is deluged with overcapacity in its vast warehousing and distribution business, which he captained during most of his 23 years at the firm. Some wondered whether he had faced the firing squad.

In fact Mr Clark's move looks to have been a voluntary one—with a hint of masochism. After doing a job that would have finished off most people, namely blitzkrieging through the retail landscape to bombard the world with Amazon packages, he now wants to prop up firms battling to get to grips with global supply chains. In doing so, Mr Clark leaves behind him a severe headache for Andy Jassy, Amazon's boss. The titan of e-commerce is not just overbuilt and overstaffed. For the first time in its 28-year history it is in the midst of an inflationary whirlwind, which is playing havoc with its ability to predict the future. The situation is bad enough in Amazon's American heartland. It is worse in its operations elsewhere. That makes it harder to fix.

When looking at Amazon, most attention is paid to its North American retail business—mainly the United States, but also Canada and Mexico. It accounts for the vast bulk of sales, almost 60% in the first quarter. The hinterland, which is to say its international business, includes dozens of countries, from Japan to India, parts of western Europe and elsewhere, that punch well below their weight. Strange as it sounds to non-Americans tied

to the tyranny of the doorbell, collectively they contribute just 25% of Amazon's overall sales. Amazon Web Services, the fast-growing cloud business, makes up the rest.

Unsurprisingly, then, Amazon's frenetic logistics drive in the past two years began at home. Since the early days of the covid-19 pandemic, the firm realised that lockdowns would fuel demand for online shopping. It threw caution to the wind and went on a domestic warehouse-building and hiring binge. In two years, as Marc Wulfraat of MWPVL, a logistics consultancy, puts it, Amazon created as much fulfilment square footage as Walmart, America's ubiquitous supermarket giant, has built in half a century. Its logistics business, started only in 2014, has leapfrogged FedEx and is catching up with UPS. Amazon's total workforce almost doubled after 2019, to 1.6m. The feat was a Herculean one—with Hydra-headed consequences when inflation and covid-19's contagious Omicron variant hit. In round numbers, overbuilding, overstaffing and inflation each added \$2bn to Amazon's costs in the first quarter, year on year, driving it into the red. The next epic task is to squeeze those costs out.

This is where the rest of the world becomes a big problem. For cost control may prove harder abroad than at home. Although Amazon says it will keep building American fulfilment centres, it plans to sublease some of the space until demand recovers. It also hopes to reduce staffing through attrition and allow third-party sellers to use some of the spare capacity. It assumes that domestic retail growth will pick up later this year. Prologis, the world's largest warehouse operator (and a big supplier to Amazon), showed similar faith in the future on June 13th when it agreed to buy Duke Realty, an American rival, for \$26bn.

Look outside the United States and such optimism becomes harder to sustain. Amazon's international business is, as in America, awash with overcapacity. But whereas North American sales grew by 8% year on year in

the first quarter, in the rest of the world they shrank by 6%. Worse, in some big foreign markets, such as Britain and Germany, conditions may be deteriorating. Mark Shmulik of Bernstein, a broker, notes that overall e-commerce penetration is shrinking in Britain and mainland Europe for the first time in years. Consumer confidence is plummeting. Europe's woes may be exacerbated by its proximity to the war in Ukraine. They may also be a harbinger of trouble in America.

Some of the deep-seated problems in these non-American markets were easy to make light of when business was booming, but loom larger now. The biggest is profitability. Amazon's international operations are almost perennially loss-making, mainly because of the huge amounts of cash it is ploughing into expansion; the losses were particularly severe in the first three months of this year. Another is spending power. Mr Wulfraat calculates that Amazon sells \$881-worth of stuff and services a year for every American. No other country comes close; the figure is \$436 in Britain, \$97 in Italy and \$13 in Mexico. Third, in the poorer regions where the company operates, such as India and Latin America, the infrastructure is shoddy and local competition intense. That makes it look like it is throwing good money after bad.

Amazon says it intends to continue its international expansion. It believes the slowdown in e-commerce penetration in Europe is partly a reaction to excessive dependence on online shopping during lockdowns. And whatever happens to the world economy, Amazon is confident that the structural shift from offline to online commerce is real and permanent.

| *Cutting down the Amazon*

When Jeff Bezos was running the company he founded, few would have second-guessed such assumptions. But this is new leadership in turbulent times. Mr Jassy, who took the helm less than a year ago, is still on probation. If Amazon's forecasts are correct, pretty soon the successor to

Mr Clark will be building yet more warehouses and Amazon will be back to the races. If they are wrong, the newish CEO may have little choice but to consider reducing Amazon's exposure to some of the more peripheral parts of its hinterland. Would he have the guts? ■



熊彼特

亚马逊面对海外市场难题

这家“一网打尽”的公司网撒得太大了

每个战时军需官都知道，只有当情况变得非常糟糕的时候，他才会被人注意到——或者被拉去枪毙。在物流行业里也是如此。因此最近一条新闻引起了市场关注：亚马逊前物流总管戴夫·克拉克（Dave Clark）离开了这家总部位于西雅图的网络巨头，出任航运软件公司Flexport的CEO。在他离职之时，亚马逊庞大的仓储和配送业务正为产能过剩所困，而在他任职的23年里，大部分时间都是负责这块业务。有些人不禁怀疑他是否曾被押上刑场。

事实上，克拉克此举应该是出于自愿，而且还带有一丝自虐的意味。他以往的功绩足以秒杀大多数人——用闪电战扩张零售业版图，让亚马逊的包裹轰炸全球各地。而他现在又要去支持那些与全球供应链困境作战的公司。但这样一来，克拉克把一个非常头疼的问题留给了亚马逊的老板安迪·贾西（Andy Jassy）。这家电商巨头不仅仅已经扩张过度、人员过剩。成立28年来，这也是它头一次处于通胀旋风之中，而通胀严重影响了它预测未来的能力。亚马逊在其核心市场美国的情况相当不妙。但其他地方还要更糟。这使得问题更加棘手。

在考察亚马逊时，人们最关注的是其北美零售业务——主要是美国，但也包括加拿大和墨西哥。这一业务贡献了很大一部分销售额，在第一季度几乎占到60%。它的腹地也就是国际业务包括几十个国家，涵盖从日本到印度、西欧部分地区以及其他地方，它们的销售贡献与自身经济体量毫不相称。天天盼着快递员按门铃的非美国人可能想不到，这些地区总共只占了亚马逊总销售额的25%。其余销售额来自快速增长的云业务AWS。

因此毫不意外，亚马逊过去两年疯狂扩张物流布局是从本土市场开始的。自疫情暴发早期，公司就意识到封锁将刺激网购需求。它把谨慎抛到了九霄云外，在美国大肆兴建仓库和招聘员工。物流咨询公司MWPVL的马克

· 沃尔夫拉特（Marc Wulfraat）说，亚马逊在两年内建造的履单中心面积相当于美国无所不在的超市巨头沃尔玛半个世纪的建设总量。它的物流业务在2014年才起步，现在已超越了联邦快递，正在逼近UPS。自2019年以来，亚马逊的员工总数几乎翻了一番，达到160万。随着通胀和高传染性奥密克戎毒株来袭，这一惊人壮举也带来了诸多问题。粗略算来，过度建设、超员和通胀每一项都在第一季度给亚马逊同比增加了20亿美元的成本，令它陷入亏损。下一个史诗级的任务就是要压缩这些成本。

在这种情况下，美国以外的市场便成为了一个大问题，因为海外成本控制可能比本土更难。尽管亚马逊表示将继续在美国建设履单中心，但也计划将部分空间转租出去，直到需求恢复。它还希望通过自然减员来收缩员工队伍，并让第三方卖家利用它的部分闲置产能。亚马逊认为美国零售增速将在今年晚些时候回升。6月13日，全球最大的仓储运营商（也是亚马逊的一大供应商）安博（Prologis）同意以260亿美元收购其美国竞争对手杜克房地产（Duke Realty），对未来表露出类似的信心。

放眼美国以外，这种乐观情绪变得更难维持。亚马逊的国际业务和本土业务一样产能严重过剩。但是，第一季度北美的销售额同比增长8%，而世界其他地区却下降了6%。更糟糕的是，在英国和德国等一些大型海外市场，情况可能正在恶化。券商盛博（Bernstein）的马克·什穆里克（Mark Shmulik）指出，英国和欧洲大陆的电子商务整体渗透率多年来首次萎缩。消费者信心正在急剧下跌。由于乌克兰战场近在身边，欧洲的困境还可能进一步加剧。而这可能也预示美国市场的麻烦将至。

在商业繁荣时期，美国以外市场的一些深层次问题很容易被忽视，但现在它们越来越突出。最大的问题是盈利。亚马逊的国际业务几乎常年亏损，主要是因为投入了大量现金用于扩张；今年前三个月的亏损尤为严重。另一个问题是消费力。据沃尔夫拉特计算，亚马逊一年平均向每个美国人销售价值881美元的商品和服务。没有任何国家能与之媲美——英国是436美元，意大利是97美元，而墨西哥只有13美元。第三个问题是，在印度和拉丁美洲等较贫困的市场，当地基础设施简陋而竞争激烈。这看起来就像在填无底洞。

亚马逊表示它打算继续国际扩张。它认为，欧洲的电子商务渗透率放缓，一定程度上是对封锁期间过度依赖网购的一种反应。而无论世界经济如何变化，亚马逊坚信商业从线下到线上的结构性转变是真实而永久的。

| 亚马逊瘦身

换在创始人贝索斯掌舵之时，没有人会质疑这样的假设。但现在是新领导身处动荡期。贾西上任不到一年，目前仍在试用期。如果亚马逊的预测是正确的，那么克拉克的继任者很快还将建造更多仓库，亚马逊将重新加速扩张。如果判断错误，位子还没坐热的CEO可能别无选择，只能考虑减少亚马逊在其腹地市场中更外围部分的风险敞口。他有这个胆量吗？ ■



The Economist Film

Solar geoengineering: is it worth it? (Part 1)

The risks of solar geoengineering must be weighed against the chance it could save millions from heat waves.



经济学人视频

太阳地球工程能否利大于弊？（上）

必须权衡太阳能地球工程的风险以及它令数百万人免受致命热浪侵袭的潜力。



Wire fraud

How one journalist exposed the Wirecard scandal

Dan McCrum recounts his battle to expose the truth about the tech firm

Money Men. By Dan McCrum. Bantam Press; 352 pages; £20

Europe has long struggled to produce world-beating technology firms. Wirecard was, for a while, viewed as a sign that this might be changing. The Munich-based payments-processor, a “fintech” star, even won a coveted place in Germany’s dax stockmarket index in 2018, when its value soared above €20bn (\$23bn). But after a spectacular fall from grace in 2020, all that remains is an insolvent husk.

Wirecard might still be one of Europe’s most feted tech firms, were it not for a small band of sceptics—including Dan McCrum. The investigative journalist at the Financial Times (FT) first heard about the company in 2013, jotting down its name with a question mark after a hedge-fund manager suggested he look under the bonnet. Over seven years, aided by a handful of short-sellers and carefully cultivated whistleblowers, he pieced together a picture of a firm built on fraud, with fake customers, invented profits and cash balances that looked flimsier the closer you got.

The battle to expose the truth had to be waged on several fronts. Wirecard fought back viciously and dirtily. Computers were hacked, offices suspected of being bugged, false stories put about. At one point, according to an ex-policeman the author interviewed, Wirecard had more than 30 private detectives “running round London” and trying to dig up dirt on Mr McCrum, FT colleagues and the short-sellers. This induced paranoia: Mr McCrum took to keeping his notebooks in a safe with six-inch steel walls, and jumping off Tube trains just as the doors were closing, in case he was being tailed.

The company also made full use of Britain's strict libel law, hiring Schillings and other firms to pound the FT with legal threats. Lawyers from another practice, alleges Mr McCrum, "played the part of the waiter carrying the tray, taking no view on whether its client had poisoned the drinks". (Schillings told him it acted entirely properly and complied with all legal and regulatory obligations.) Wirecard also sued in its homeland, spuriously accusing the paper of misusing its business secrets; the suit was dropped.

This response slowed Mr McCrum down, at one point causing a damning article to be spiked for fear of an injunction. The stories he was able to publish had to be toned down. A reader complained that one was like a French film: "I've read all the subtitles, I've paid attention, but I have no idea what the ending was all about."

Wirecard's critics also had to contend with its boosters in markets and the media. Many investors, caught up in the general tech optimism, refused to believe Wirecard could be rotten, even as the incriminating evidence mounted. Such frauds are common in China, but in orderly Germany? The highest-profile believer was SoftBank, which poured \$1bn into Wirecard in 2019, assuaging other investors' growing doubts—and cementing its own reputation as one of the world's least discerning tech investors. Equity analysts bought the lie, too. In 2019, more than five years after the first reports of accounting shenanigans, just two of 26 analysts covering the stock recommended selling it.

The German establishment, meanwhile, buried its head in the sand, or worse. Politicians refused to condemn Wirecard; some accused its critics of envy. The German press, including Handelsblatt, the business newspaper of record, mostly swallowed the firm's line that the attacks on it were illegal moneymaking schemes, or part of an Anglo-Saxon plot to destroy a continental European champion. The financial regulator investigated the FT and short-sellers (for alleged market manipulation) rather than the

company, and, citing Wirecard's "importance for the economy", banned the shorting of its stock.

Woven into the tale are colourful portraits of the two men who ran Wirecard: its perma-optimistic, turtleneck-wearing chief executive, Markus Braun, and Jan Marsalek, the cunning, narcissistic chief operating officer. Mr Marsalek, an Austrian tech whiz with a taste for the high life and a solid-gold credit card—as well as shadowy connections to intelligence services in Russia and Libya—allegedly orchestrated much of the fraudulent activity. He never stopped thinking big, even advancing an unrealised last-minute plan to distract attention from Wirecard's sins by taking over Deutsche Bank. Mr Braun has been charged with fraud, breach of trust and accounting manipulation; he denies wrongdoing. Mr Marsalek is on the run, wanted by Interpol.

Wirecard finally ran out of road when it failed to convince KPMG, brought in to conduct a special audit, that €1.9bn it claimed to hold in two Asian banks was really there. Mr McCrum was vindicated: due reward for over half a decade of digging. The short-sellers finally made a profit—though one called it "the worst wage he'd ever made", given all the time and money spent.

"Money Men" has flaws. Digressions into the world of payments-processing and the inner workings of the FT make a complicated story more so. The end is rushed: it could have done with more on the soul-searching, or lack of it, in Germany since Wirecard's demise. Nevertheless, the book should be required reading for investors and financial regulators. It is a compelling case study of a seemingly eternal truth: when a business is built on lies, there are always clues. You just have to be willing to see them—even if that means swallowing some national pride. ■



支付骗局

一名记者如何揭露Wirecard丑闻

丹·麦克勒姆忆述自己揭发这家科技公司真相的战斗【《谋财的人》书评】

《谋财的人》。作者丹·麦克勒姆。矮脚鸡出版社；352页；20英镑。

欧洲长期以来都苦于难以培育出世界一流的科技公司。人们一度认为Wirecard的出现显示这种局面可能正在改变。这家总部位于慕尼黑的支付处理公司是颗“金融科技”明星，甚至还在2018年令人艳羡地被纳入德国DAX股票市场指数，市值一举冲破200亿欧元（230亿美元）。但在2020年，它令人咋舌地跌落神坛，之后只剩下一个资不抵债的躯壳。

要不是一小群人觉得事有蹊跷，Wirecard说不定至今仍是欧洲最受追捧的科技公司之一。丹·麦克勒姆（Dan McCrum）就是其中一人。这位英国《金融时报》的调查记者第一次听说这家公司是在2013年，当时一名对冲基金经理建议他挖一挖这家公司。他记下了它的名字，在旁边打了个问号。在七年多的时间里，他在一些卖空者和小心拉拢来的吹哨人的帮助下，拼凑出了一副建立在欺诈之上的公司的图景：客户是假的，利润是编的，现金结余也是越仔细看就越觉薄弱。

这场揭露真相的战斗不得不多线展开。Wirecard发起了反击，手段毒辣又下作。电脑被黑，办公室被疑似遭窃听，谣言四处散播。据作者采访的一名前警察称，Wirecard一度让30多名私家侦探“跑遍伦敦”，试图挖出麦克勒姆以及他在《金融时报》的同事还有卖空者的黑料。这让人变得神经兮兮：麦克勒姆开始把笔记本放在一个用6英寸厚的钢板制成的保险箱里，并在地铁车门即将关闭时跳出车厢，以防有人跟踪。

Wirecard还充分利用英国严格的诽谤法，雇用Schillings等律所来用法律风险打击《金融时报》。麦卡勒姆指控另一家律所的律师“扮演了端着托盘的服务员的角色，对自己的客户是否在饮料中下了毒不闻不问”。

（Schillings告诉他自己的操作完全正当，符合所有法律和监管要

求。) Wirecard也在本国提起诉讼，虚假指控该报滥用其商业秘密，后来又撤诉。

Wirecard的反应延缓了麦克勒姆的步子，有一次还导致一篇谴责性的稿子被毙，因为担心会触发禁令。而他那些最终发出来了的报道也不得不缓和措辞。一名读者抱怨说其中一篇就像法国电影：“我把字幕一字不落地看了，我看得很专心，但还是不知道结局在讲什么。”

Wirecard的批评者还不得不与它在市场和媒体圈子里的支持者交战。许多投资者沉浸于对科技行业普遍的乐观情绪中，拒绝相信Wirecard会是一只臭鸡蛋，即使它的罪证越来越多。这种欺诈在中国不鲜见，但在循规蹈矩的德国居然也有吗？它最高调的信徒是软银，该公司在2019年向Wirecard注入了10亿美元，缓解了其他投资者渐增的疑虑，巩固了自己“世界上眼力最差的科技投资者之一”的名声。股票分析师对谎言也很买账。2019年，在第一波关于会计欺诈的报道发布五年多后，关注该公司股票的26名分析师中只有两人建议卖出。

与此同时，德国当权派把头埋进了沙子里，或者更糟。政客们拒绝谴责Wirecard，有些还指责批评者是出于嫉妒。包括权威商业刊物《商报》(Handelsblatt)的德国媒体大多全盘接受了该公司的说辞，即对它的攻击都是谋取钱财的非法勾当，或者是盎格鲁-撒克逊人摧毁欧洲大陆领军企业的阴谋的一部分。金融监管机构调查了《金融时报》和卖空者(指控他们操纵市场)而不是Wirecard，并以该公司“对经济的重要性”为由禁止卖空它的股票。

故事中还穿插了对Wirecard两个掌门人的生动刻画：一个是永远乐观、爱穿高领毛衣的首席执行官马库斯·布劳恩(Markus Braun)，另一个是狡猾而自恋的首席运营官简·马萨里克(Jan Marsalek)。后者是个来自奥地利的技术达人，喜好奢靡的生活，有一张纯金信用卡，还与俄罗斯和利比亚的情报机构暗通款曲。据称是他策划了大部分欺诈活动。他自始至终都想干大事，甚至在最后关头还提出收购德意志银行(Deutsche Bank)来转移人们对Wirecard罪行的注意力，不过没能实现。布劳恩被指控欺

诈、背信和会计操纵；他否认有不当行为。马萨里克目前仍在逃，被国际刑警组织通缉。

Wirecard最终走到了穷途末路，因为它无法说服请来做特别审计的毕马威相信它声称存放在两家亚洲银行的19亿欧元确实存在。麦卡勒姆沉冤得雪：他辛苦挖掘了七八年，这是他应得的回报。卖空者最终获得了利润——尽管有人说这是“他赚过的最差劲的工资”，毕竟花费了那么多时间财力。

《谋财的人》也有瑕疵。关于支付处理业务和《金融时报》内部运作的题外话让一个复杂的故事更加复杂。结尾也有些仓促：作者本可以多着些笔墨探讨德国自Wirecard塌楼以来有何自我反省，或者多么缺乏自省。即便如此，投资者和金融监管者都应该读一读这本书。这是一个令人信服的案例研究，证明了一个似乎永恒的真理：当一家企业建立在谎言之上，就总会露出马脚。你要做的就只是愿意正视它们——即使这意味着要放下一些民族自尊心。■



The \$500bn question

The EU has begun debating how to fund the reconstruction of Ukraine

Where will it find the money required and how will it prevent it being wasted?

On February 23rd the Azovstal factory in Ukraine's port city of Mariupol was one of the biggest steel plants in Europe, 11 square kilometres of blast furnaces and liquid metal. Its 11,000 workers poured more than 4m tonnes of steel a year. On February 24th the war began, and three months later Azovstal lay in ruins. Russia has reduced most of Mariupol, and other towns in eastern Ukraine, to burnt-out husks. Russian missiles and artillery have smashed railway stations, ports and telecoms towers, hit more than 1,000 schools and left roads and wheat fields pocked with craters. The physical damage came to \$104bn at the end of May, according to the Kyiv School of Economics and the economy will shrink by up to 50% this year.

Ukraine's allies have promised cash to keep the country running during the war, and to rebuild it afterwards "to help a new Ukraine rise from the ashes of war", says Paolo Gentiloni, the eu's economy commissioner. An accurate estimate of the total cost is impossible, but guesses are in the range of \$200bn-500bn and rising. One question is where to get the money. Another is how to organise the aid without running foul of institutional rules or political sensitivities. Finally, there is the question of whether Ukraine can handle the cash.

The prospect of paying for reconstruction dwarfs more immediate issues, such as keeping Ukraine's government solvent. "If we see that...there is no discussion of how to share the cost, then we are concerned," says an Italian official. The eu could borrow the money collectively, as it did for its covid-recovery splurge. This idea has support among cash-strapped members. France may also see such a fund as a welcome chance to enhance Europe's role in international affairs.

But Germany is hesitant, partly because it worries about high public debt and partly because collective EU debt tends to anger its powerful constitutional court. The Dutch government agreed to the covid-recovery fund only as a one-off, and is reluctant to break that promise to voters.

Then there is the question of who spends the money, and on what. The European Commission has proposed a “Rebuild Ukraine” platform that it would supervise alongside the Ukrainian government. It would co-ordinate aid from the EU and its member states, other countries (including America, Britain, Canada, Japan and South Korea) and international lenders such as the IMF, the World Bank and the EBRD. Ukraine would take the lead in drawing up a reconstruction plan: it has already formed working groups of domestic stakeholders and international donors.

Everyone accepts that the EU should have a leading role, not least because Ukraine aims to join the club. Some worry, though, that the EU’s bureaucracy and need for consensus will slow it down. Furthermore, not all interested parties are members of the union. America and Britain play big roles in Ukraine’s war effort, and institutions like the World Bank have their own rules and priorities. This argues for a looser sort of co-operation among different donors. The EU may focus on institutional reforms, economic integration and development, while America helps Ukraine build up its armed forces and defence industry. The IMF would guide the restructuring of Ukraine’s debt and launch a new lending programme. Individual countries will take credit for their own aid projects.

Such decentralisation risks duplication. The scramble for funds, both by Ukrainians and foreign contractors, will be fierce. It could also make it harder for anti-fraud agencies to spot corruption. Ukraine has the worst score in Europe on Transparency International’s corruption perceptions index, apart from Russia. It has improved since protests toppled a crooked government in 2014, instituting a transparent public procurement system

and an independent anti-corruption investigator. Some say its poor image stems partly from Russian propaganda, but all stress the need for more accountability.

One way to reassure donors would be to work with foreign contractors experienced in big infrastructure projects, says Natalie Jaresko, a Ukrainian-American who was Ukraine's finance minister in 2014-16.

Another might be to establish a court with foreign judges to adjudicate disputes linked to reconstruction. Bringing private-sector investment to a war-racked country with a reputation for corruption will take some doing. Yet the flowering of Ukrainian patriotism during the war will help.

"Ordinary people on the streets are getting involved, scrutinising plans and discussing cost calculations of rebuilding projects," says Oleg Ustenko, an economic adviser to Volodymyr Zelensky, Ukraine's president. "Everybody believes that things related to the country are related to themselves."

Read more of our recent coverage of the Ukraine crisis. 



5000亿美元问题

欧盟已开始讨论如何为乌克兰的重建提供资金

它将在哪里找到所需的资金以及如何防止浪费？

2月23日，位于乌克兰港口城市马里乌波尔的亚速钢铁厂是欧洲最大的钢铁厂之一，拥有11平方公里的高炉和液态金属。其11000名工人每年浇注超过400万吨钢材。2月24日战争爆发，三个月后，亚速钢铁厂沦为废墟。俄罗斯已经将马里乌波尔的大部分地区和乌克兰东部的其他城镇变成一片焦土。俄罗斯的导弹和大炮摧毁了火车站、港口和电信塔，袭击了1000多所学校，把道路和麦田变得千疮百孔。根据基辅经济学院（Kyiv School of Economics）的数据，截至5月底，实物损失达到1040亿美元，今年经济将萎缩多达50%。

欧盟经济专员保罗·真蒂洛尼（Paolo Gentiloni）表示，乌克兰的盟友已承诺提供现金，以在战争期间维持该国运转，并在战后重建“以帮助新的乌克兰从战争的废墟中崛起”。要准确估计总成本是不可能做到的，但猜测在2000亿至5000亿美元之间，而且还在不断上升。一个问题是从哪里弄到钱。另一个是如何在不违反制度规则或触及政治敏感性的情况下组织援助。最后，还有乌克兰能否用好这些钱的问题。

支付重建费用的前景让一些更紧迫的问题显得小巫见大巫，例如如何保持乌克兰政府不破产。“如果我们发现.....没有讨论如何分摊成本，那么我们就该担心了。”一位意大利官员说。欧盟可以集体借钱，就像它为新冠疫情复苏所做的那样。这个想法得到了资金紧张的成员的支持。法国也可能将这样的基金视为加强欧洲在国际事务中的作用的可喜机会。

但德国犹豫不决，一则是担心高额公共债务，一则是欧盟集体债务往往会激怒其强大的宪法法院。荷兰政府只是一次性同意设立新冠恢复基金，并且不愿违背对选民的这项承诺。

然后是谁能花钱、花在哪里的问题。欧盟委员会提出了一个“重建乌克兰”

的平台，它将与乌克兰政府一起监督。它将协调来自欧盟及其成员国、其他国家（包括美国、英国、加拿大、日本和韩国）以及国际货币基金组织、世界银行和欧洲复兴开发银行等国际贷款机构的援助。乌克兰将带头制定重建计划：它已经成立了由国内相关方和国际捐助者组成的工作组。

各方都同意欧盟应该发挥主导作用，尤其是因为乌克兰的目标是加入该俱乐部。不过，有些人担心欧盟的官僚作风和对共识的需求会减慢它的速度。此外，并非所有相关方都是欧盟成员。美国和英国在乌克兰的战争进程中扮演着重要角色，世界银行等机构则有自己的规则和优先事项。这就使得不同的捐助方之间更适合开展一种较松散的合作。欧盟可能专注于体制改革、经济一体化和发展，而美国则帮助乌克兰建立其武装部队和国防工业。国际货币基金组织将指导乌克兰债务重组并启动新的贷款计划。各个援助项目的功劳就归在相应的国家身上。

这种去中心化有造成重复的风险。乌克兰人和外国承包商对资金的争夺将非常激烈。这也可能使反欺诈机构更难发现腐败。除俄罗斯外，乌克兰在透明国际的腐败认知指数中是欧洲得分最低的。自2014年抗议活动推翻了一个不诚实的政府以来，情况已有所改善，建立了透明的公共采购系统和一个独立的反腐调查部门。有人说乌克兰糟糕的形象部分源于俄罗斯的宣传，但所有人都强调需要加强问责制。

2014至2016年担任乌克兰财政部长的乌克兰裔美国人娜塔莉·亚雷斯科（Natalie Jaresko）说，让捐助者放心的一种方法是与在大型基础设施项目方面经验丰富的外国承包商合作。另一个可能是建立一个由外国法官组成的法院来裁决重建相关争议。将私营部门投资带到一个饱受战争蹂躏、以腐败著称的国家需要一些工作。不过，战争期间乌克兰爱国主义情绪高涨将有所帮助。“街上的普通人正在参与进来，审查计划并讨论重建项目的成本计算，”乌克兰总统沃拉迪米尔·泽伦斯基的经济顾问奥列格·乌斯坚科（Oleg Ustenko）说，“每个人都认为‘国家兴亡，匹夫有责’。”





Sanctions and Russia

Why the West should be wary of permanently seizing Russian assets

It is a seductive idea, but would also be a mistake

More than 100 days into the war in Ukraine, the biggest sanctions programme ever imposed on a major economy is still being tightened. America and Europe have frozen Russia's currency reserves held in Western banks. On June 3rd the European Union joined America and Britain in placing a partial embargo on Russia's oil exports, and also cut off Sberbank, its largest lender, from the SWIFT interbank messaging system. A motley crew of oligarchs and their toys have been sanctioned. In Fiji the Amadea, a 100-metre superyacht with a helipad and pool, is the subject of Western actions, as are private planes in Dubai and Chelsea football club in England.

Sanctions have caused serious disruption to Russia's economy and if kept in place will impair its performance for years. Even so, their limitations are clear. Owing to high energy prices—Brent crude costs about \$120 a barrel—Vladimir Putin's regime is enjoying bumper revenues. Because only Western countries and a handful of Asian allies are enforcing sanctions, many customers continue to buy Russian oil. As a result, by the end of 2023 its crude production is expected to be only about 20% below its pre-war level. Kremlin-linked tycoons are still free to travel much of the world. Russian missiles continue to slaughter civilians in Ukraine and devastate its economic capacity.

The bill for rebuilding Ukraine's smashed cities and repairing its ruined industrial base will be huge: upwards of \$600bn, according to some estimates. That has got many people wondering if the West should shift from merely freezing Russian assets temporarily to confiscating them permanently. They could then be used to pay for the reconstruction that lies ahead.

Russia has about \$300bn of reserves held in the West and up to another \$1trn of mainly private-sector assets held abroad. On May 19th Ursula von der Leyen, the president of the European Commission, said that the EU was looking into asset seizures. The G7 has discussed using them, too.

The idea that the aggressor should pay for the damage it has caused is appealing and popular. But the legal justification, and strategic logic, of sanctions are that they impair a country's capability to pursue a course of action and may change its behaviour, because if that country alters its path the assets will be released. A shift from this approach to a policy of permanent seizure would be a big step that would be justifiable only if two tests are passed. The first is that any new policy is compatible with the rule of law. And the second is that it has a clear strategic pay-off.

Start with the rule of law. In America the president has the authority to freeze a foreign government's assets but not typically to seize them unless America is at war with that country. Ever since Russia invaded Ukraine, President Joe Biden has been at pains to say America is not in open conflict with it. The executive branch can transfer control over certain foreign assets when it stops recognising a country's government, as with some funds that belong to Venezuela and Afghanistan. However, America says it does not seek regime change in Russia.

Under international law, reparations usually involve the consent of the paying country, typically as part of a peace treaty. Such negotiations are a long way off, and Ukraine must not be forced into them. Seizing assets owned by individuals, however odious they are, before they have been convicted by a court is also dubious. In some countries, such as Germany, doing so may violate the constitution.

What about the West's strategic interests? In the short run, permanent seizure would make no difference to the Kremlin's ability to fund its deadly

war machine, since Mr Putin's regime cannot use the foreign assets that have already been sanctioned and frozen. In the long run, the precedent set by confiscations without a clear legal footing would expose all cross-border assets, including Western ones, to tit-for-tat appropriation by governments. It would also give a further incentive for countries that are not allied with America, or which have unstable relations with it, to bypass the American-led financial system, which is a bedrock of Western power.

Rather than resorting to asset confiscations, the West must strengthen Ukraine's war effort. That means supplying more heavy weapons and speeding up their deployment and the training of Ukrainian forces to use them. It means maintaining sanctions for as long as Russia wages its war and occupies Ukraine. And it means making clear that even if no peace deal is signed, and no Russian reparations are ever paid, Europe and America will still have to foot a large part of the bill for rebuilding Ukraine's shattered economy. ■



【首文】制裁与俄罗斯

为什么西方应对永久没收俄罗斯资产态度谨慎

这个想法很诱人，但会是个错误

乌克兰战争已持续了100多天，有史以来对一个主要经济体实施的最大规模制裁仍在加强中。美国和欧洲已经冻结了俄罗斯在西方银行的外汇储备。6月3日，欧盟加入了美国和英国的行列，对俄罗斯的石油出口实施了部分禁运，并切断了其最大的银行俄罗斯联邦储蓄银行（Sberbank）与银行间消息传递系统SWIFT的联系。各形各色的寡头和他们的大玩具也都受到了制裁。在斐济，一艘100米长、带直升机停机坪和游泳池的超级游艇Amadea号成了西方的制裁对象，在迪拜的私人飞机和英格兰的切尔西足球俱乐部也一样。

制裁严重扰乱了俄罗斯经济，继续实施的话，将有损该国未来多年的发展。即便如此，制裁的局限性也很明显。由于能源价格高企（布伦特原油价格约为每桶120美元），普京政府收入颇丰。由于只有西方国家和它们在亚洲的少数盟国在实施制裁，许多国家仍在继续购买俄罗斯石油。其结果是，到2023年底，俄罗斯原油产量预计仅会比战前水平低20%左右。与克里姆林宫有关联的大亨仍可在世界大部分地区通行无阻。而俄罗斯导弹继续在乌克兰屠杀平民，摧毁其经济能力。

要重建乌克兰被蹂躏的城市和修复其遭毁坏的工业基础将耗资巨大，有估计认为将超过6000亿美元。这让许多人西方人琢磨是否不应仅仅暂时冻结俄罗斯资产，而应改为永久没收。这些资产以后可被用于支付重建费用。

俄罗斯在西方有约3000亿美元的外汇储备，另外还在国外持有高达1万亿美元资产，主要是私营部门资产。5月19日，欧盟委员会主席乌尔苏拉·冯德莱恩（Ursula von der Leyen）表示，欧盟正在就没收资产展开研究。七国集团也已讨论过使用这些资产的问题。

侵略者应为其造成的损失买单的想法很有吸引力，也很受欢迎。但制裁的法律依据和战略逻辑是，制裁会削弱一国采取某种行动的能力，并可能改变其行为，因为如果该国改弦更张，资产就会被释放。从这种方式转变为永久没收政策将是一大转变，只有能通过两项测试才是正当的。一是任何新政策都符合法治。二是它有明确的战略回报。

先说法治。在美国，总统有权冻结外国政府的资产，但通常无权没收，除非美国与该国外战。自俄罗斯入侵乌克兰以来，拜登一直在努力表明美国与俄罗斯没有公开冲突。如果行政机关不再承认一国政府，它可以转移对某些外国资产的控制权，比如属于委内瑞拉和阿富汗的一些资金就是被这样处理的。然而，美国表示它并不谋求改变俄罗斯的政权。

根据国际法，赔偿通常需要得到赔偿国的同意，这往往是一项和平条约的一部分。这场战争距离这样的谈判还早，而且绝不能强迫乌克兰参加。无论某些个人多么可恶，在被法院定罪之前就没收其资产的正当性也存疑。在德国等国家，这样做可能违宪。

那么西方的战略利益呢？在短期内，永久没收资产不会影响克里姆林宫为其致命战争机器提供资金的能力，因为普京政府本就已经无法使用被制裁和冻结的外国资产。长远来看，一旦开了在没有明确法律依据的情况下没收资产的先例，包括西方资产在内的所有跨境资产都有可能被其他政府以牙还牙侵占。这还可能进一步促使未与美国结盟或与美国关系不稳定的国家绕过美国主导的金融体系，这可是西方力量的基石。

西方必须加强乌克兰的作战能力，而不是诉诸于没收资产。这就意味着要为乌克兰提供更多重型武器，加快部署这些武器及训练乌军使用它们。这也意味着只要俄罗斯继续作战并侵占乌克兰，制裁就要持续下去。并且，要明确即使没有签署和平协议，也没有俄罗斯的赔偿，欧洲和美国也仍须为重建乌克兰被重创的经济担负很大一部分费用。 ■



Real-life problems

China ponders the humans behind “virtual idols”

Should they have more rights?

Whether it's for marketing or entertainment, hiring a real-life celebrity is expensive and carries risks. Several Chinese stars have been caught up in scandals recently. Some get into trouble for being out of step with the Communist Party. The party, for its part, has attacked fan culture, banning online rankings of celebrities. It wants public figures to be upstanding role models. Little wonder, then, that many Chinese firms are choosing to work with “virtual idols” instead of the human kind.

Virtual idols are generated by computers. Often, though, these digital avatars are controlled by anonymous human performers wearing motion-capture gear. The most popular virtual idols sing and dance before millions of viewers on live-streaming platforms. Fans tip real money and buy merchandise. Some virtual idols are influencers or used in marketing campaigns. It makes for big business. China's virtual-idol market was estimated to be worth nearly \$16bn in 2021, says iiMedia, a consultancy.

Virtual idols have problems, too, though. Take Carol (pictured), the lead singer of A-SOUL, one of China's most popular virtual bands. Its creators are backed by ByteDance, a Chinese tech giant. Carol alone generated over 2m yuan (\$300,000) in revenue, mostly from tips, in a single month last year, according to reports. But in May it was announced that Carol was leaving A-SOUL. According to fans, the performer behind the virtual idol had complained that she was bullied, overworked and underpaid. Her employers denied all of this, noting that human performers receive 10% of live-stream earnings. Nevertheless, the virtual Carol has disappeared.

Such issues will inevitably arise as Chinese firms pursue opportunities in

the metaverse. They poured billions of yuan into such ventures last year; ByteDance spent a small fortune on Pico, a maker of virtual-reality headsets. A paper published in October by the China Institutes of Contemporary International Relations, a state think-tank, spoke of the need for laws and regulations surrounding “virtual labour”. Young people, meanwhile, are increasingly fed up with “996” schedules (ie, working 9am to 9pm six days a week). Virtual idols offer them an escape. But behind some avatars are humans with similar gripes. ■



现实问题

中国关注“虚拟偶像”背后的真人

他们是不是该有更多的权利？

无论是为了营销还是娱乐，聘请真人明星都既昂贵又有风险。近年好几个中国明星都卷入了丑闻。有的是因为没有与党步调一致而惹上麻烦。而党已经开始整治饭圈文化，禁止在网上给明星排名。它希望公众人物树立正派榜样。难怪许多中国公司选择与“虚拟偶像”而不是真人合作。

虚拟偶像由电脑生成。不过，这些数字化身通常都是由穿戴着动作捕捉设备的匿名人类扮演者控制。人气最高的虚拟偶像在直播平台上面对数百万观众唱歌跳舞。粉丝们用真金白银打赏并购买商品。有些虚拟偶像成了网红，或被用于营销活动。这门生意可以做得很大。艾媒咨询表示，2021年中国虚拟偶像市场价值估计近160亿美元。

不过，虚拟偶像也存在一些问题。以中国最走红的虚拟乐队之一A-SOUL的主唱珈乐（如图）为例。它的制作方得到了中国科技巨头字节跳动的支持。据报道，去年仅珈乐一人在单月创造的营收就超过200万元人民币，其中大部分来自打赏。但今年5月，制作方公告称珈乐离开A-SOUL。据粉丝透露，这位虚拟偶像的幕后扮演者抱怨自己受欺凌、超负荷工作、薪水过低。她的雇主对此全盘否认，并指出真人扮演者能拿到直播收入的10%。尽管如此，虚拟的珈乐还是销声匿迹了。

随着中国企业试水元宇宙，此类问题将不可避免地出现。去年，中国企业在这类项目上注资数十亿元；字节跳动在VR头显制造商Pico上花了一大笔钱。国家智库中国现代国际关系研究院去年10月发表的一篇文章谈到了需要就“虚拟劳工”问题制定法律规范。与此同时，年轻人越来越难以忍受“996”工作制（每周工作六天，每天从早上9点工作到晚上9点）。虚拟偶像带给他们一时的解脱。但一些虚拟角色的背后是有着类似抱怨的真人。





Chain reaction

The structure of the world's supply chains is changing

The pandemic and war in Ukraine have speeded up the transformation

Supply chains are the fibres out of which the past decades' globalisation is woven. Time and again they have allowed intrepid outward-looking manufacturers to undercut their stay-at-home competitors and component-makers to find roles in new markets.

Networks of aircraft, email and container ships, not to mention railways and pipelines, have tied together businesses in Guangdong and Oregon, Durban and Dubai, Rennes and Punta Arenas. Masters of their use, such as Airbus or Apple, can create technological marvels from components provided in dozens of different countries using raw materials brought in from yet farther afield.

Over the past five years the tensions pulling at this fabric have been growing stronger. First came America's tariffs on Chinese exports. Then the covid-19 pandemic boosted demand for a particular constellation of goods while constraining their production and transport. Most recently Russia's war in Ukraine sent commodity prices soaring and reminded firms how quickly a political shock can close one market and wreak havoc in others.

Governments and companies have a history of wringing their hands over such things but not, in the end, doing much to change them. This time things are different. As James Zhan of the United Nations Conference on Trade and Development wrote in a recent article, "The decade to 2030 is likely to prove a period of transformation for global value chains." That transformation is already under way.

The direction of change is clearly visible in data on inventories, investment

and hiring; its effects are in the news around the world. Apple's shift of some production from China to Vietnam has whipped up a war for talent in the country. Chinese firms have filled up a giant industrial park in Monterrey, Mexico, in hope of meeting American customers' demand from closer to home. In May alone, Samsung, Stellantis and Hyundai announced \$8bn of investment in American electric-car factories.

Decision-makers are increasingly concerned that supply chains should be robust, not just efficient. As a result they are choosing to depend less on jurisdictions where they are exposed to risk. And countries are experimenting with industrial policies aimed at self-reliance or international pre-eminence in at least some "strategic" technologies and businesses. This means supporting investment in such sectors within their borders and sometimes restricting the export of the fruits of those sectors. Companies, for their part, are buying up suppliers at home and abroad in the name of vertical integration.

The market-based and Sino-centric system that started to emerge towards the end of the past century is being transformed into something which, though still global, is less unitary and more costly. This should ultimately turn out to be less fragile. But the transition will be messy enough to create shocks of its own.

"There are centrifugal and centripetal forces that pull the world together or apart," notes Douglas Irwin, a trade historian at Dartmouth College. Today's shift is not a swing from one extreme to the other; it is a strengthening of the centrifugal coupled with a weakening of the centripetal, which had, until recently, been at an historic high.

Beginning in the 1990s, technology, geopolitical stability and the search for efficiency and comparative advantage were powerful pullers-together. Unshackled from geography by better communications and more efficient

containerised shipping, companies skipped from continent to continent in search of cheap inputs and thicker profit margins.

Global flows of foreign direct investment (FDI) had been worth 0.5% of global GDP in the 1970s and 1980s. By the mid-2000s they were worth 5% or more. This, in turn, created a global marketplace. In the two decades to 2008, trade as a share of global GDP jumped from 37% to 61%.

| *I'm coming out*

Even before the covid-19 pandemic there were ample signs that globalisation had become slowbalisation. The share of American firms' revenues that came from abroad was mostly flat; profits earned abroad were falling. Flows of trade and FDI had stagnated. One reason was automation, which reduced the labour intensity of manufacturing and therefore the competitive advantage of lower-wage countries that had become offshoring hubs in the 1990s and 2000s. Another was that wages in those countries rose.

In 2000 China's average annual income per person expressed in dollars, a reasonable proxy for the wage costs facing a multinational firm, was 3% of America's. That is one reason why the country's accession to the World Trade Organisation the following year was so transformative. By 2019 that had risen to 16%.

The fragility of the system had become more obvious, too. The Tohoku earthquake of 2011 shut down Japanese car suppliers and dented silicon-wafer production. Flooding in Thailand later that year submerged a hub of hard-drive manufacturing. But worries about such risks failed to prompt much action.

A recent paper by researchers at the World Bank concluded that the disasters in Japan "did not lead to reshoring, nearshoring, or

diversification”. The trade war with China which President Donald Trump started in 2018 saw corporate executives talk excitedly about supply-chain reshuffling. Yet there was little evidence for such a trend. In 2019 China still controlled more than one-quarter of the suppliers for big industries, including chemicals, electronics and textiles, according to the Conference Board, a research group.

The covid-19 pandemic proved a dislocation large enough for concern to beget consequences. In its early days governments scrambled, often unsuccessfully, to secure protective clothing and hospital ventilators. Changes in patterns of consumption away from in-person services and towards manufactured goods brought new bottlenecks into being. More recently China’s vainglorious attempt to maintain zero covid, punctuated by on-and-off lockdowns, has led to further disruption. Hundreds of ships were left dawdling pointlessly off Shanghai—an image of dysfunction now stuck in people’s minds.

The effects of Russia’s invasion of Ukraine have provided further, more profound shocks. It has disrupted markets in energy and, crucially, food in ways which highlight the need for more broadly based supplies. It has also made manifest the geopolitical risks of dependence on an autocracy with aggressive ambitions. That has further intensified concerns about China.

Thus economic dependency has become a cause for action, not just concern. This is most obvious in energy markets. Europe is working desperately to build up its gas inventories as well as its capacity to import liquefied natural gas (LNG). In May NextDecade, an American energy company, announced a 15-year deal to sell LNG to France’s Engie which will catalyse investment in a sprawling new export terminal along the Louisiana coast. Some senior Democrats are murmuring about easing their opposition to the Keystone XL pipeline from Canada. New infrastructure and long-term contracts are pushing a global, fluid system in the direction

of one less efficient but more secure.

Dependency worries are also seen in manufacturing. The range of goods that governments deem critical has expanded well beyond the realms of defence and post-pandemic public health. “We cannot allow countries to use their market position in key raw materials, technologies, or products to have the power to disrupt our economy or exercise unwanted geopolitical leverage,” Janet Yellen, America’s treasury secretary, said in April. American export restrictions now include biotechnology software and the wherewithal for producing advanced semiconductors.

Industrial policy is increasingly de rigueur. More than 100 countries accounting for over 90% of the world’s GDP now have formal industrial strategies, according to a survey by the UN, with a particular frenzy of activity in recent years. Policies run the gamut from investments in basic research to those that shield “strategic” industries from foreign competition.

Many are informed by a growing appreciation of the size and scope of the industrial shift implicit in plans for net-zero emissions. The European Commission is dangling subsidies in front of makers of batteries and semiconductors. In America, where President Joe Biden began his term with a “Buy American” executive order, subsidies to help industry compete with China have attracted bipartisan support.

| *Reach out and touch*

There is little evidence of rich countries “reshoring” production from abroad. In America imports form an ever-larger share of domestic manufacturing output—a sign that manufacturers are becoming more reliant on foreign suppliers, not less. American spending on factories, warehouses and the like, relative to GDP, is only a tiny bit higher than it was in the early 2010s, and far lower than it was in the 1970s and 1980s. Across

the OECD club of mostly rich countries manufacturing's share of GDP is around 13%, an all-time low.

But although reshoring is minimal, what happens off which shores is changing, as companies come to their own conclusions as to whether the risk of trying a new model exceeds the risk of sticking with the old. One fairly simple approach is to sign contracts with additional suppliers. Fully 81% of supply-chain leaders surveyed by McKinsey this year are now sourcing raw materials from two suppliers, rather than depending on merely one. Evidence from Goldman Sachs, a bank, suggests that America is broadening the number of countries on which it relies for supplies, a trend that is mirrored in other rich countries. This does not in itself deliver robustness—if capacity does not increase, then a shock will still cut supply in the aggregate. But big capital-expenditure plans suggest that companies are trying hard to forestall such an eventuality.

Companies are also building up inventories—half-finished or finished products, left in reserve, which can be sold if demand suddenly ramps up or if fresh supply fails. This has big costs in terms of tying up money. The world's 3,000 biggest companies have increased their holding by the equivalent of 1% of global GDP since 2019, according to The Economist's analysis—and they want to do more.

The fact that industries are bearing those costs shows that they fear supply problems more than they used to. They may be paying for time to weigh their options and see how others respond before taking hard-to-reverse decisions such as moving plant or people. Some may think that larger inventories are a necessary response to supply-chain risks in perpetuity.

One family of hard-to-reverse decisions are those involved in vertical integration—either building the capacity to be your own supplier or buying up companies that already have that capacity. In some sectors this is a

growing trend, driven both by supply-chain concerns and a desire to snatch back profit margins from suppliers.

The American computer sector is about 50% more vertically integrated than in the mid-2000s, as measured by the share of the industry's gross revenues accruing to companies in that industry (rather than outside suppliers). Vertical integration in the American car sector, meanwhile, jumped around 2019. Chinese firms have a dominant position in both the production of batteries and the processing of minerals required for them. So multinational carmakers elsewhere are building their own battery plants and even investing in mines.

Wariness of China is prompting broader changes, too. Official statistics regarding FDI into China show it going from strength to strength, but these numbers are hard to reconcile with other sources. Another measure is "greenfield" FDI—the sort of capital injection that builds new offices or factories. Since 2019 China has commanded less than 10% of global greenfield-FDI inflows, down from a peak of close to 20% in the mid-2000s (see chart 3).

The number of OECD countries whose equity FDI into China was smaller than their disinvestment from it was zero in 2005. According to analysis by The Economist, that number had reached eight, or a fifth of the club, by 2019.

Employment tells a similar story. The share of American multinationals' staff based in China is drifting downwards. At the same time those companies are boosting recruitment in other parts of Asia. They employ nearly 400,000 people in the Philippines, a 10% rise since 2016. Nearly 1.4m people in India work for American companies, a 14% rise from 2016.

| *Ain't no mountain high enough*

Other parts of Asia are the main beneficiaries of the not-China shift. In 2015 the total value of big democracies' FDI in China exceeded their comparable investment elsewhere in East Asia by 20%. Now those positions are reversed. In 2021 OECD countries imported roughly \$700bn-worth of Chinese-made "intermediate" goods (raw materials, components and the like), representing a modest increase from 2018. But imports of the same type of goods from Vietnam grew by 70% over the period.

There is plenty of increased investment elsewhere, too. The largest greenfield FDI projects announced in the past year have been Intel's \$19bn chip factory in Magdeburg, Germany, and Samsung's \$17bn chip factory in Taylor, Texas. On an annual basis Taiwan is injecting more than twice as much FDI equity into OECD countries as it did in the early 2010s.

Inward FDI figures for Mexico—a country forever talked up by apostles of nearshoring—remain unremarkable, but leading indicators of change are discernible. Firms that help suppliers relocate production to Mexico are being inundated with requests from Chinese companies looking to set up shop, according to Patrick Van den Bossche of Kearney, a consultancy. In May a company called Zipfox, which helps American businesses search for suppliers in Mexico, saw the volume of new customers on its website increase by 20%.

Mexico's appeal is largely down to the access to markets elsewhere in North America provided by the US-Mexico-Canada Agreement. Similar trade deals could make the restructuring of supply chains easier and cheaper. Unfortunately, America's leaders show no interest in persuading voters this would be worth doing.

Redesigning supply chains takes time, and noticing an effect takes even longer. The boss of a giant American manufacturer which now produces

90% of its products in China says it plans to boost investment in American and European manufacturing dramatically over the next five years. That will still leave China producing about half its goods. But the shift is under way.

The considerable costs of taking more than efficiency into account will fall on taxpayers, companies and consumers. The benefits should in principle be felt widely, too. But they may not be readily apparent. The world economy could become less vulnerable to shocks at a time when climate change and geopolitical tensions are increasing their frequency and intensity. Improving resilience could be a case of running to stand still.

Indeed some of the underlying tensions may be exacerbated. Attempts to boost economic security can create shocks of their own. This year the spectre of new tariffs on imported solar panels brought American solar projects to a standstill.

Increased economic integration did not bring about the greater global harmony that some had hoped it would. It is difficult to imagine that fragmentation will do much better, and it is all too easy to imagine it making things worse. That could be one of the reasons why, for a long time, changes to the fundamental shape of globalisation were much talked about but not much pursued. Now they are actually happening, they are contributing significantly to the new anxiety.

On this week's Money Talks podcast, we discuss the changes to the structure of the world's supply chains. ■



链式反应

全球供应链结构正在发生变化

疫情和乌克兰战争加速了这一转型【深度】

供应链就像纤维，编织出过去几十年的全球化。它们一次又一次让勇于出击的外向型制造商以低于本地竞争对手和零部件制造商的价格在新市场中找到机会。

飞机、电子邮件和集装箱船构成的网络——更不用说还有铁路和油气管网——把位于广东和俄勒冈、德班（Durban）和迪拜、雷恩（Rennes）和蓬塔阿雷纳斯（Punta Arenas）的企业连接在一起。空客或苹果等善用供应链的大师可以利用几十个不同国家提供的组件创造技术奇迹，而生产这些组件所用的原材料来自更遥远的地方。

在过去五年里，撕扯这张网络的各种力量越来越强。先是美国对中国出口产品加征关税。接着新冠疫情推高了对特定商品的需求，同时又限制了它们的生产和运输。最近，俄乌战争导致大宗商品价格飙升，提醒企业政治动荡可以多么快速地封闭一个市场，并对其他市场造成严重破坏。

历史上政府和公司常因这类事情着急上火，但最终也没做什么去改变它们。这一次情况有所不同。正如联合国贸发会议的詹晓宁在最近一篇文章中所写的，“2030年之前的这十年很可能会是全球价值链的转型期”。这种转变已经在进行中。

从库存、投资和招聘数据中可以清楚地看到转变的方向，在世界各地的新闻报道中都可以看到它的影响。苹果将部分生产从中国转移到了越南，在该国引发了一场人才争夺战。墨西哥蒙特雷市（Monterrey）的一个巨大工业园区里充斥着中国公司，它们希望能从更近的地点满足美国客户的需求。仅在5月一个月里，三星、Stellantis和现代宣布要在美国投资80亿美元建设电动汽车工厂。

决策者越来越关注供应链是否稳健，而不只看效率。因此，他们选择减少对存在风险的司法辖区的依赖。各国正在试验各种产业政策，目标是至少在某些“战略性”技术和业务上实现自力更生，或取得国际领先地位。这意味着它们会在国内支持对此类部门的投资，有时还会限制这些部门的产品或服务出口。而企业则以垂直整合的名义收购国内外供应商。

上个世纪末开始出现的基于市场和围绕中国的供应链体系正在变形。虽然新系统仍然是全球性的，但不再那么单一，成本也更高了。它最终应该不会再那么脆弱。但过渡期会很混乱，足以造成冲击。

“离心力和向心力让世界分崩离析或凝聚在一起。”达特茅斯大学的贸易历史学家道格拉斯·欧文（Douglas Irwin）指出。今天的转变不是从一个极端转向另一个极端，而是离心力加强，向心力减弱。而在不久前，向心力一直处于历史高位。

从上世纪90年代开始，科技、稳定的地缘政治，以及对效率和比较优势的追求是强大的凝聚力。更好的通信技术和更高效的集装箱运输让企业摆脱了地理位置的束缚，它们从一个大陆跳到另一个大陆，不断寻找低成本的投入品和更高的利润空间。

在上世纪70和80年代，全球外国直接投资（FDI）流量占全球GDP的0.5%。到2000年代中期，该比例已达到5%或更高。这反过来又创造了一个全球市场。在截至2008年的二十年间，贸易占全球GDP的比重从37%跃升至61%。

| 动作来了

甚至在疫情之前，就有充分的迹象表明全球化已经变成了慢球化。美国公司来自国外的收入份额基本保持不变，在国外赚取的利润正在下降。贸易和FDI增长已经停滞。自动化是一个原因，它降低了制造业的劳动强度，从而削减了在90年代和2000年代成为离岸外包中心的低工资国家的竞争优势。这些国家的工资上涨是另一个原因。

按美元计算的人均年收入这个指标可以较好地体现跨国公司面对的工资成

本。2000年，中国的人均年收入是美国人均年收入的3%。中国次年加入世贸组织具有重大的变革意义，原因之一正在于此。到2019年，这一比例上升到了16%。

全球供应链系统的脆弱性也已变得更加明显。2011年的日本东北大地震导致日本汽车供应商停产，也影响了硅片生产。同年早些时候，泰国的洪水淹没了一个硬盘制造中心。但对此类风险的担忧未能促成太多实际行动。

世界银行的研究人员最近发表的一篇文章认为，日本的灾难“并未导致制造业回流、近岸生产或多元化”。特朗普于2018年对中国发起贸易战，企业高管激动地谈论起供应链重组。然而，几乎没有证据表明真有这种重组的趋势。根据研究机构世界大型企业联合会（Conference Board）的数据，2019年中国仍控制着包括化工、电子和纺织在内的大型产业超过四分之一的供应商。

疫情导致的供应混乱之严重足以让担忧变成实际后果。在疫情初期，各国政府争先恐后地抢购防护服和医用呼吸机，但经常买不到。消费模式从面对面服务转向制成品的变化形成了新的瓶颈。近来，中国自负地坚持清零政策，时不时实施封锁，让供应更为混乱。成百上千船只漫无目的地飘荡在上海港外，这幅运转失灵的画面如今在人们脑海中挥之不去。

俄罗斯入侵乌克兰的影响让供应链受到进一步更深重的冲击。战争扰乱了能源等市场，尤其是粮食市场，突显了对多源供应的需求，同时也暴露出依赖具侵略野心的专制政权会带来的地缘政治风险。这进一步加深了对中国的担忧。

因此，经济依赖已成为采取行动的理由，而不只是引发担忧。这在能源市场上最为突显。欧洲正竭力建立天然气库存以及进口液化天然气的能力。5月，美国能源公司NextDecade宣布了一项向法国Engie出售液化天然气的协议，合同为期15年，这将促进对路易斯安那州沿海一个庞大的新出口终端的投资。一些资深民主党人正在私下讨论缓和他们对于加拿大Keystone XL输油管道项目的反对态度。新的基础设施和长期合同正在推动一个畅通

的全球性系统朝着效率较低但更安全的方向演进。

对依赖性的担忧也出现在制造业中。被政府认为具有战略重要性的商品已远远超出国防和后疫情公共卫生领域的范围。“我们不能允许其他国家利用它们在关键原材料、技术或产品方面的市场地位来破坏我们的经济，或发挥不利于美国的地缘政治影响力。”美国财政部长珍妮特·耶伦（Janet Yellen）4月表示。美国的出口限制现在包括生物技术软件和先进半导体制造设备。

产业政策越来越严格。联合国的一项调查显示，占全球GDP90%以上的100多个国家现在都制定了正式的产业战略，近年来的动作尤其频繁。这些政策涵盖从基础研究投资到保护“战略”产业免受外国竞争等方方面面。

人们越来越意识到为实现净零排放所制定的计划会导致规模大、范围广的产业转型，这影响了许多决策。欧盟委员会正在用补贴来鼓励电池和半导体制造商。在美国，拜登上任伊始就签署了《购买美国货》（Buy American）的行政令，提供补贴以帮助工业界与中国竞争，赢得了两党的支持。

| 主动出击

没什么证据表明富裕国家正在让生产从国外“回流”。在美国，进口占国内制造业产出的份额越来越大，表明制造商对外国供应商的依赖是在增加而不是减少。美国在工厂、仓库等方面的支出占GDP之比仅比2010年代初略高了一点点，远低于上世纪七八十年代。在成员以富裕国家为主的经合组织中，制造业仅占GDP的约13%，创历史新低。

尽管制造业回流很少，但离岸生产的具体方式正在发生变化，因为关于尝试新模式的风险是否大于坚持旧模式，企业正在得出自己的结论。一种相当简单的做法是与更多供应商签订合同。麦肯锡今年调查的供应链领袖足有81%现在通过两家供应商采购原材料，而不是仅仅依赖一家。来自高盛的证据表明，美国正在让更多的国家成为它的供应方，其他富裕国家也有同样的趋势。这样做本身并不能确保稳健性，因为如果产能没有增加，冲

击仍会导致总体供应减少。但庞大的资本支出计划表明，企业正在努力避免这种可能性。

企业也在增加半成品或成品的储备库存，如遇需求突增或无法获得新供应，便可拿来出售。这会占用大量资金，成本很高。根据本刊分析，自2019年以来，全球最大的3000家公司增加的库存相当于全球GDP的1%，而且它们还想继续增加。

行业能容忍这些成本表明它们比过去更担心供应问题。它们这样做可能是在争取时间，看看手头的选项以及同行作何反应，然后才会做出迁移工厂或人员等难以逆转的决定。有些企业可能认为，增加库存是应对供应链风险而必须采取的永久性措施。

一类难以逆转的决策涉及垂直一体化，即公司要么自己建立供应能力，要么收购已具备供应能力的公司。在某些行业，这种趋势在不断加强，这既是出于对供应链的担忧，也是出于从供应商那里夺回利润空间的愿望。

根据行业内公司（而不是外部供应商）在行业总收入中所占份额来衡量，美国计算机行业的垂直一体化程度比2000年代中期提高了约50%。与此同时，美国汽车行业的垂直一体化在2019年左右猛然加剧。中国公司在电池生产和电池矿物材料加工方面均占据主导地位。因此，其他地方的跨国汽车制造商正在建设自己的电池厂，甚至投资矿山。

对中国的警惕也在带来更广泛的变化。官方统计数据显示流入中国的FDI不断增加，但这些数字很难与其他来源对得上。另一个指标是“绿地”FDI，即用于建造新办公室或工厂的注资。自2019年以来，中国占全球绿地FDI流入的比例不到10%，低于2000年代中期接近20%的峰值（见图表3）。

2005年，对中国的股权FDI少于从中国的撤资的经合组织国家数量为零。根据本刊的分析，到2019年，这一数字已达到八个，占该组织成员国数量的五分之一。

就业数据也显示出相似的趋势。美国跨国公司在中国的员工比例正在下降。与此同时，这些公司正在亚洲其他地区增加招聘。它们在菲律宾雇用了近40万人，自2016年以来增加了10%。印度有近140万人为美国公司工作，比2016年增加了14%。

| 无畏高山

亚洲其他地区是生产向非中国地区转移的主要受益者。2015年，大型民主国家在中国的FDI总额比它们在东亚其他地区的同类投资多20%。现在的情况反了过来。2021年，经合组织国家进口了价值约7000亿美元的中国制造“中间品”（原材料、零部件等），与2018年相比略有增加。但从越南进口的同类商品在同期增长了70%。

其他地方的投资也在大量增加。去年宣布的最大的绿地FDI项目是英特尔在德国马格德堡（Magdeburg）190亿美元的芯片工厂和三星在得克萨斯州泰勒市（Taylor）170亿美元的芯片工厂。台湾每年向经合组织国家注入的股权FDI是2010年代初的两倍多。

墨西哥这个国家向来都为近岸投资的信徒们津津乐道，流入该国的FDI数据仍不起眼，但一些主要指标显示变化清晰可见。咨询公司科尔尼

（Kearney）的帕特里克·范登波奇（Patrick Van den Bossche）表示，帮助供应商把生产转移到墨西哥的公司现在收到了大量想在当地建厂的中国公司的咨询。5月，在帮助美国企业在墨西哥寻找供应商的公司Zipfox的网站上，新客户数量增加了20%。

墨西哥的吸引力主要是它能进入北美其他市场，这是《美墨加协定》（US-Mexico-Canada Agreement）带来的好处。类似的贸易协议也许能让供应链的重组更容易，也更便宜。可惜的是，美国领导人没有表现出有兴趣说服选民这样做是值得的。

重新设计供应链需要时间，而要看到效果所需的时间还要更久。一家美国大型制造商现在有90%的产品在中国生产，它的老板表示公司计划在未来五年内大幅增加对美国 and 欧洲制造业的投资。未来它仍会有约一半的产品

在中国生产。但这种转变已经在进行中。

像这样将效率之外的诸多因素纳入考量将产生可观的成本，而这将由纳税人、公司和消费者承担。原则上来说其益处应该也会泽被广泛，但可能不会立竿见影。在气候变化和地缘政治事件变得日益频发、强度愈高之际，世界经济可能会变得没那么脆弱。而如果大家都努力提高韧性，很难有谁脱颖而出。

一些潜在的紧张局势确实可能会恶化。加强经济安全性的尝试本身就可能制造冲击。今年，由于担心进口太阳能电池板被征收新的关税，美国的太阳能项目陷入了停顿。

经济一体化程度的提高并没有如一些人希望的那样让世界更和谐。很难想象碎片化会带来多大改善，倒是很容易想象它会把事情变得更糟。这或许可以帮助解释，为什么长久以来，人们反复讨论改变全球化的基本形态，却没有太多行动。现在改变正在切实地发生，它们又大大加剧了新的焦虑。





Human capital in the 21st century

How modern executives are different from their forebears

They need to work harder at more tasks, and to deploy softer skills

Spiritual growth is an odd mandate for business schools preparing graduates to make manna in a secular world. One such institution, HEC Paris, has nevertheless decided to send students on a trek through the French countryside to a remote village, where a Benedictine monk (a former lawyer) guides them through ethical dilemmas. Whether or not the three-day seminar represents a shift away from the profit-driven logic of business and towards a kinder, gentler form of capitalism is up for debate. But it shows that expectations for what makes a great MBA programme—and, by extension, a great executive—are in flux.

MBA courses (our ranking of which you can find at economist.com/whichmba) used to focus on number-crunching and business strategy. Executives must still master these skills. Yet the corporate world has changed since the MBA first became a rite of passage for high-powered executives. Management teams answer to a growing number of “stakeholders”, from employees to social activists, and face public scrutiny on their companies’ environmental, social and governance (ESG) record. Simply creating shareholder value no longer cuts the mustard.

One consequence of this trend is that running a modern business requires an ever-expanding list of credentials and competences. In addition to financial and digital literacy, strategic acumen and communication skills, executives are expected to be clued in on supply chains, climate science and much else besides. They must ensure that their workforces are diverse and inclusive. And as work life goes hybrid, mixing time in the office with home working, they are also asked to spend more time checking in on subordinates.

Some of these new duties are delegated to new corporate roles. Prince Harry is the “chief impact officer” of a Silicon Valley firm. Clifford Chance, a law firm, has appointed a global “wellbeing and employee experience” chief. Nearly 5,000 people on LinkedIn, a social network, describe themselves as “chief happiness officers”. Still, most high-ranking managers will almost certainly need to perform each of these novel tasks to a greater or lesser extent.

Since a day has 24 hours—and even hard-charging executives need sleep—their workload is changing. Devoting more time to employees and other stakeholders leaves corporate leaders less for other things, including mission-critical ones like coming up with a strategy for their firm. Since 2006 Michael Porter and Nitin Nohria of Harvard Business School have tracked what CEOs do all day. They find that bosses spend 25% of their working lives on fostering relationships with insiders and outsiders, more than they devote to strategy (21%), corporate culture (16%), routine tasks (11%) and dealmaking (4%).

Although Messrs Porter and Nohria do not yet have the relevant data, anecdotal evidence suggests that hybrid work may be skewing executives’ workday even more towards people management. Human-resources chiefs report that managers spend more time hand-holding staff, for example. Bosses were hybrid workers before covid-19. The pre-pandemic CEOs spent around half their time in the office and the rest in external meetings, travelling or otherwise working remotely. More than a third of their communications was via video chat, email or the phone. The difference now is that everyone else spends just as little time in the office—if not less. This further reduces opportunities for face-to-face contact, which makes building relationships with employees more difficult, and almost certainly more time-consuming.

As the 21st-century executive’s workload is changing, so too are MBA

curriculums. Many institutions are busily incorporating new, cuddlier modules. Harvard Business School now has one entitled “Reimagining capitalism”. Instead, a French organisation, teaches students about “Business and society”. Plenty of MBA programmes offer courses on interpersonal skills. Some are tailoring classes for the Zoom age, for example pointing out the common traps of virtual negotiations. That necessarily leaves less time for other, more traditional instruction.

A few schools are even fundamentally rethinking their recruitment policies to reflect the evolving character of modern management. That may involve conducting group interviews to assess candidates’ soft skills rather than their intellect alone, or screening candidates for emotional traits such as empathy, motivation and resilience through questionnaires, letters or essays. Changes to whom business schools recruit, as well as to what they teach, may in turn affect who applies. Given that a business-school degree is designed in part to send a powerful signal of executive competence, that may determine what type of person rises up the corporate pecking order. It might not be your parents’ MBA. ■



21世纪人力资本

现代高管与他们的前辈有何不同

他们要更努力地完成更多任务，并且运用更加软性的技能

对于让毕业生准备好到世俗世界中赚取神赐面包的商学院来说，精神成长是一项奇怪的教学任务。不过巴黎高等商学院（HEC Paris）还是决定让学生们在法国乡村徒步跋涉，去到一个偏远的村庄，那里有一位曾做过律师的本笃会修士指导他们解决道德困惑。这场为期三天的研讨会是否标志着利润驱动的商业逻辑转向了更友好、更温和的资本主义形式？这一点还有待商榷。但它表明，人们对优秀的MBA课程——乃至优秀的高管——的期待正在不断变化之中。

MBA课程（本刊的一项排名可参见economist.com/whichmba）过去专注于捣弄数字和商业战略。高管们仍然必须要掌握这些技能。不过，自MBA开始成为高层管理人员的成人礼以来，企业界已经发生了变化。管理团队要应对从员工到社会活动家的越来越多的“利益相关者”，还要面对公众对公司环境、社会和治理（ESG）记录的审视。单单创造股东价值已经不能让人满意了。

这一趋势的后果之一是，经营现代企业需要一个越来越长的资质和才能清单。除了金融和数字化素养、战略敏锐度和沟通技巧外，高管们还要了解供应链、气候科学等许多其他方面的知识。他们必须保证员工队伍多元化且有包容性。而随着工作渐趋混合化——在办公室和居家工作之间交错切换，他们还要花更多的时间查看下属的工作状况。

其中一些新职责交给了公司中的新角色。哈里王子是硅谷一家公司的“首席影响官”（chief impact officer）。高伟绅律师事务所（Clifford Chance）任命了一位全球“福祉和员工体验官”（wellbeing and employee experience）。社交网络领英上有近5000人自称“首席幸福官”。不过，大多数高层管理人员几乎肯定或多或少要做这些新任务的每一项。

因为一天只有24小时——而再有干劲的高管也得睡觉——他们的工作量正在变化。要投入更多时间到员工和其他利益相关者身上，企业领导者做其他事情的时间就少了，包括为公司制定战略等关键任务。哈佛商学院的迈克尔·波特（Michael Porter）和尼汀·诺瑞亚（Nitin Nohria）自2006年以来一直在跟踪CEO们每天都在做什么。他们发现，老板们将25%的工作时间花在与内外部人员建立关系上，比他们在战略（21%）、企业文化（16%）、日常工作（11%）和交易达成（4%）上的投入都多。

尽管波特和诺瑞亚尚无相关数据，但坊间流传的证据表明，混合式工作可能正让高管的工作日进一步向人员管理倾斜。例如，人力资源主管称，管理人员现在花更多时间指导和支持员工。新冠疫情爆发前，老板是混合式工作者。疫情之前，CEO有大约一半的时间待在办公室里，其余时间花在外会议、出差或其他方式的远程工作上。他们三分之一以上的交流是通过视频聊天、电子邮件或电话进行的。现在的变化是其他人在办公室的时间也一样少了——甚至可能更少。这进一步减少了面对面接触的机会，使得与员工建立关系更困难了，而且几乎可以肯定也更加耗时。

随着21世纪高管的工作量改变，MBA课程也在发生变化。许多商学院都在忙着加上更招人喜欢的新课程模块。哈佛商学院现在开设了名为《重新构想资本主义》的课程。法国的欧洲工商管理学院（INSEAD）教授《商业与社会》。很多MBA项目提供人际交往技巧课程。有些课程为Zoom时代量身定做，比如指出虚拟谈判的常见陷阱。这必然会缩减其他更传统课程的教学时间。

一些学校甚至正从根本上重新考虑招生政策，以契合现代管理不断演变的特点。这可能包括组织小组面试来评估候选人的软技能，而不仅仅评估才智；或者通过问卷、信件或短文，根据同理心、干劲和韧性等情感特征做筛选。商学院录取的对象变了，教学内容也变了，这可能反过来又会影谁去申请。既然商学院学位的作用之一是释放强有力信号，表明已具备做高管的能力，这可能决定了哪种类型的人能在公司里一路上升。它可能已经不是你父母那会儿的MBA了。 ■



The other da Vinci code

Where did the “Mona Lisa” smile?

Look over her shoulders for clues

For centuries, two of the most intriguing questions about Leonardo da Vinci’s “Mona Lisa” were “Who?” and “When?” A discovery made at Heidelberg University in 2005 pretty much answered both. A note written in a manuscript in the library confirmed the account of da Vinci’s first biographer, Giorgio Vasari: that the sitter was a merchant’s wife, Lisa Gherardini. The note also helped date the masterpiece to between 1503 and 1506.

A third conundrum—“Where?”—is still in dispute. But on June 3rd a French engineer, Pascal Cotte, declared that he and a collaborator had identified the landscape in the background of the painting. Arguments had previously been made for stretches of countryside in the Marche region and between Milan and Genoa. During a presentation in Vinci, near Florence, Mr Cotte contended that the artist was more plausibly depicting a part of his native Tuscany—one that keenly interested him at the time. According to this theory, da Vinci represented the area not as it was, but as, in an unrealised scheme, he intended it to be.

Mr Cotte, who was asked by the Louvre (where the “Mona Lisa” hangs) to create a digital image of the painting, is the inventor of the multispectral camera: a device that can detect not only the drawing below the surface of an oil painting, but also, where they exist, intermediate layers of work. It was among these, under what appears to be a pointed rock, that he found a preparatory sketch showing that da Vinci intended it to represent a castellated tower.

The landscape of the “Mona Lisa” also includes a huge overhanging

precipice. That is similar to one that da Vinci included in a sketch of a fortress contested by Pisa and Florence in the war that flared between them in 1503 (around the time he was painting Gherardini). The fortress with the nearby precipice—and a tower, known as the Caprona tower—all overlook the river Arno as it snakes from Florence to Pisa. All three also feature in drawings made by da Vinci to illustrate a plan about which, says Mr Cotte, he became “obsessive”.

This involved diverting the Arno to cut off Pisa’s water supply and give Florence an outlet to the Mediterranean. In the early 1500s, with the two city-states at war, the idea was under active consideration. Mr Cotte argues that a channel winding through desolate countryside at the right of the “Mona Lisa” is too wide to be a road, as some have speculated, and is instead the dried-up bed of the Arno as da Vinci envisaged it once his plan had been adopted.

It never was. But if Mr Cotte’s theory is right, it might just explain why Gherardini, a Florentine, wears such a contented, if inscrutable, smile. ■



另一个达芬奇密码

《蒙娜丽莎》在哪里微笑？

从她的身后找线索

几个世纪以来，关于达芬奇的《蒙娜丽莎》两个最令人感兴趣的问题是“谁？”和“什么时候？”。2005年，海德堡大学的一项发现基本上给出了答案。该校图书馆一份手稿上的一段笔记证实了第一位达芬奇传记作家乔治·瓦萨里（Giorgio Vasari）的记述：画中人是一名商人的妻子丽莎·盖拉尔迪尼（Lisa Gherardini）。这条笔记也帮助确认了这副画创作于1503年至1506年之间。

第三个谜题——“在哪里？”——仍存在争议。但在6月3日，法国工程师帕斯卡尔·科特（Pascal Cotte）宣布他和一位合作者已经确定了这幅画中的背景所在。此前曾有人论证那是马尔凯地区的乡村地带，也有人说在米兰和热那亚之间。科特在佛罗伦萨附近的芬奇（Vinci）举行的一次演讲中提出，画家更有可能是在描绘他的家乡托斯卡纳（Tuscany）的一部分——当时他对这里非常感兴趣。根据这个理论，达芬奇并不是按这个地方的本来面目呈现它，而是按他的一个未实现的计划中的景象画的。

卢浮宫（悬挂《蒙娜丽莎》的地方）要求科特创建这幅画的数字图像。科特是多光谱相机的发明者，这种设备不仅可以探测到一幅油画表层下方的草图，还可以测出中间层——如果有的话。正是在这幅画的中间层里，他发现在一块貌似尖石的东西下方有一幅草图，显示达芬奇本来要在这个位置画一座城堡形塔楼。

《蒙娜丽莎》的远景中还有一块巨大的悬崖峭壁。达芬奇曾有一幅素描，画的是比萨和佛罗伦萨在1503年（差不多就是他为盖拉尔迪尼作画的时间）爆发的战争中争夺的一座堡垒，画中也有一个类似的悬崖。堡垒、附近的悬崖，以及一座名为卡普罗纳塔的塔楼都俯瞰着从佛罗伦萨蜿蜒到比萨的阿诺河（Arno）。这三样东西也都出现在达芬奇绘制的一批规划图中，科特说达芬奇对这个计划“着了迷”。

该计划要让阿诺河改道以切断比萨的供水，并让佛罗伦萨获得通往地中海的出口。十六世纪初，随着两个城邦爆发战争，这个想法得到了积极的考虑。科特认为，位于《蒙娜丽莎》画像右侧的那条蜿蜒穿过荒芜乡间的通道太宽了，不可能像一些人猜想的那样是一条路，而是达芬奇的计划若被采纳后阿诺河干涸的河床。

这个计划从未被采纳。但如果科特的理论是正确的，它或许可以解释为何佛罗伦萨人盖拉尔迪尼会带着这样一种满足的——尽管有些难以捉摸的——微笑。 ■



The great Teslification

How supply-chain turmoil is remaking the car industry

Learning from Elon Musk

If you want to see how technology and deglobalisation are changing the global economy, there are few better places to look than the car industry. Not only is it going through an epochal shift: away from the internal-combustion engine (ICE) and towards electric vehicles (EVs). Automobiles are also becoming, in effect, computers on wheels, running as much on processing power as the horse variety. And the pandemic has wreaked havoc on car companies' complex global supply chains, most prominently of semiconductors. As carmakers electrify, computerise and refashion their supply chains for the new reality, the giant sector is undergoing the greatest transformation in decades.

Having outsourced much of the manufacturing process in the past half-century to focus on design, supplier management and parts assembly, car firms want greater control over their value chain—from the metals that go into EV batteries to the software those EVs run on and the shops in which they are sold. And they want to turn their EV arms into tech startups.

In both respects, control and startupiness, Big Auto wants to be more like Tesla, the world's undisputed EV champion. As with earlier examples of tailgating a rival that tries something that works, from Ford's moving assembly line or Toyota's just-in-time manufacturing, Teslification of the car business will prove disruptive.

Doing everything under one roof is an idea both old and new. Tesla's industrial system is at first glance an embrace of Silicon Valley's "full stack"—internalising all aspects of production, and therefore all the profits. Elon Musk, Tesla's opinionated boss, once claimed that his company was

“absurdly vertically integrated” by any standard, not just the car industry’s. In fact, Mr Musk borrows heavily from carmaking’s past. Henry Ford often sourced raw materials, like rubber for tyres and steel for chassis, from plantations and blast furnaces owned by his firm. His River Rouge factory in Detroit was powered by coal from Ford mines.

In an echo of Fordism, Tesla has struck recent deals with lithium miners and graphite suppliers, and last month confirmed a deal with Vale, a Brazilian mining giant, to purchase nickel. The plan is to acquire most of its lithium, over half its cobalt and around one-third of its nickel directly from nine mining companies. It will use those minerals in its “gigafactories”, the first of which started making batteries in 2017 in Nevada in partnership with Panasonic of Japan. It plans to make more cells on its own at its three other gigafactories around the world.

Tesla has also pulled other bits of the powertrain in-house. It makes its own motors and a lot of its own electronics, giving it more control over costs as well as over the technology, says Dan Levy of Credit Suisse, a bank. Although rumours swirling last year that Mr Musk might buy his own chip factory have faded, Tesla designs its own semiconductors and has closer links than other carmakers with those who manufacture them. That has helped it weather the global chip shortage better than rivals. Tesla’s software engineers have created a centralised computing architecture to run on those chips, ensuring smooth integration with the four-wheeled hardware. Mr Musk has even ditched the dealership-based sales model, instead opening his own swanky Tesla stores.

Jealously eyeing Tesla’s market value of \$724bn, which is roughly as much as the next nine biggest carmakers combined (see chart 1), other car bosses are desperate to emulate Mr Musk’s digger-to-dealership control. According to UBS, another bank, “integration represents a strong competitive edge in an environment of structurally tight supply chains.” As Jim Farley, Ford’s

current boss, recently declared, “The most important thing is we vertically integrate. Henry Ford...was right.”

This reverses decades of outsourcing to big suppliers such as Bosch, Continental and Denso in order to concentrate on managing supply chains, integrating separate parts, design and marketing. Suppliers sold similar components to many customers using scale to keep prices low. This freed up capital for carmakers but put technological innovation at one step removed. Carlos Tavares, chief executive of Stellantis, an Italian-American giant (whose big shareholder, Exor, also owns a stake in The Economist’s parent company), has said that his cars are 85% “bolt-on parts”. Mercedes-Benz estimates its value-added split at 70-30 in favour of suppliers.

Established car firms now want their ratios to more closely resemble Tesla’s, which Philippe Houchois of Jefferies, an investment bank, puts at 50-50 and rising in favour of in-house. This starts with raw materials. As demand for battery minerals, notably cobalt, lithium and nickel, and processing capacity continues to outstrip supply, car firms are striking deals which would have Henry Ford nodding with approval. Getting their hands dirty by short-circuiting supply chains is, in the words of one former mining titan, “extraordinary”.

BMW said in 2021 that it had put \$334m into an Argentine lithium project. Last year Stellantis and Renault each signed deals with Vulcan Energy Resources, and GM revealed a “multimillion-dollar investment” in Controlled Thermal Resources, in each case for lithium. In April Ford inked a deal with Lake Resources for the same mineral, while Stellantis and Mercedes entered an arrangement with Umicore, a Belgian chemicals giant, to supply cathode materials for ACC, the two carmakers’ battery joint venture. A month earlier BYD, a more Tesla-like Chinese firm that started out making phone batteries before turning into one of the world’s biggest EV-makers, announced a nearly \$500m investment in a Chinese lithium

miner. It is said to have bought six mines in Africa. The terms of such deals are as opaque as the sums involved are eye-catching. Car bosses agree that they will become commonplace.

Efforts to emulate Tesla's battery gigafactories are also getting into gear. Carmakers are hoping to break the stranglehold of China and South Korea on battery-making, bringing production closer to home to keep costs in check and supplies reliable. Volkswagen (VW) is creating some in-house battery-making capacity. It has earmarked €2bn (\$2.1bn) for its German factory, and says it will build six battery factories in Europe by 2030.

Plans for such fully fledged in-house battery units remain rare (see chart 2). Most companies still prefer to team up with specialist producers. Ford and SK Innovations of South Korea will stump up \$7bn and \$4.4bn, respectively, for three joint gigafactories in America. Last year GM unveiled an investment of \$2.3bn for a battery plant in Tennessee built with LG, another South Korean firm. Sometimes, as with ACC, rival car companies band together to share the cost of battery production. Stellantis and Mercedes (along with TotalEnergies, a French oil giant) will invest \$7bn in ACC factories in France and Germany. VW has a 20% stake, worth €1.4bn, in Northvolt, a Swedish firm that also counts Volvo as an investor.

Buying off-the-shelf electric motors is also falling out of favour. Hyundai and the Renault-Nissan-Mitsubishi carmaking alliance are mostly going it alone. BMW, Ford, GM, Mercedes and VW are planning to make more motors in their own factories.

Although no car boss is about to outdo Mr Musk and make the leap into chipmaking, the 7.7m cars in lost production last year as a result of the global semiconductor shortage has made the industry forge closer links with chip designers such as Qualcomm and Nvidia, which would once have sold chips to firms far down the carmakers' supply chain. The car

companies are also employing chip specialists to help them semi-tailor specifications and turn them into, as one car boss puts it, “smarter buyers”. VW is hatching plans to design its own custom silicon, as Tesla does.

Something similar is happening in software development. Last month VW’s boss, Herbert Diess, told a meeting of his employees that developing its “own software expertise is the biggest switch the automotive industry has to make”. Mr Diess’s fellow industry leaders share his analysis. In the next few years software is expected to become the biggest source of revenue for the industry. UBS reckons that worldwide car-software sales will bring in around \$1.9trn annually by 2030 (see chart 3).

In 2020 VW created a separate software arm, CARIAD, to sidestep its slow decision-making bureaucracy. Despite teething troubles with the programs for its ID.3 hatchback that surfaced at the end of 2019, the firm has recently said that it aims to develop most of its own software in 15 years’ time, up from about 10% now. That includes plans for a proprietary operating system, something that Mercedes and Toyota are also contemplating. (Ford and GM are instead adopting Google’s Android operating system.) To that end, VW plans to invest around €30bn over the next five years. Stellantis wants to hire 4,500 software engineers by 2024. Several carmakers are setting up research-and-development centres in tech hubs, from Silicon Valley to Shanghai, in order to tap those places’ existing talent pools.

As for sales, the established giants have no intention of dismantling the time-honoured dealership system. It serves useful functions in servicing, for example—as Tesla’s long-running struggles in this area illustrate. Still, more car companies are shifting to an “agency model”, selling vehicles directly to motorists, as Tesla does, rather than through a third party. Charging fixed prices could boost margins. Direct sales also forge a closer bond with buyers who might go on to purchase additional services and upgrades.

If they really want to catch up with Tesla, let alone overtake it, car companies will have to “move at Silicon Valley speed”, as Barclays, a bank, puts it. That means simplifying not just their supplier networks but their corporate structures, which have become Byzantine and siloed. As long ago as 2019 Volvo and Geely, its Chinese parent company, merged their ICE operation as a stand-alone business. That has allowed the Swedish marque to go full speed to becoming electric-only by 2030. In March Ford said that it would create an EV unit, Ford Model e, and separate it from the ICE operations. Renault is considering doing something similar, also with a view to accelerating innovation.

All this amounts to a once-in-a-century upheaval for a globe-spanning industry encompassing thousands of companies, millions of workers and billions in sunk ICE-age costs. Refashioning value chains will require spending lots of time and money, and comes with the risk of failure. For suppliers, it potentially means less business, as vertical integration makes them less central to carmaking—a prospect reflected in the sliding share prices of some, including large ones like Continental, in the past few years.

For car bosses, that means more headaches, as they consider how best to deploy their firms’ resources and skills, without provoking a backlash from governments and unions fearful of the loss of well-paying manufacturing jobs. As a result, the sector’s Teslification drive will be uneven and fitful. But the direction of travel is unmistakably Muskian.

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伟大的特斯拉化进程

供应链动荡如何重塑汽车行业

向马斯克看齐【深度】

如果你想了解科技和去全球化正在如何改变全球经济，没几个行业比汽车行业更直观了。该行业不仅正在经历从燃油车向电动车的划时代转变，汽车实际上也正在成为轮子上的计算机，依赖计算处理能力和依赖动力一样多。新冠疫情严重破坏了汽车企业复杂的全球供应链，尤其是半导体供应链。随着汽车制造商推进电气化、计算机化以及重塑供应链来适应新形势，这个庞大的行业正在经历几十年来最大的一场变革。

在过去的半个世纪里，汽车生产商为把精力集中在设计、供应商管理和零部件组装上，选择将生产过程中的很多环节外包出去。现在它们想要加强掌控自己的价值链——从制造电动汽车电池的金属，到运行电动汽车的软件，再到销售电动汽车的门店。它们还想把自己的电动汽车部门变成科技创业公司。

在控制价值链和变身科技创业公司这两方面，汽车巨头都希望自己能向特斯拉这个无可争议的全球电动车之王靠拢。之前就有这样的例子：如果对手试过某种做法后发现行之有效，比如福特的流水线生产、丰田的适时生产等等，其他车厂会很快跟上。如今汽车行业的“特斯拉化”也将展示其颠覆性。

在同一屋檐下完成所有事情是一个既古老又新鲜的想法。乍一看，特斯拉的工业体系遵循硅谷的“全栈”式企业模式——把生产的所有环节内部化，从而也把所有利润内部化。固执己见的特斯拉老板马斯克曾声称，不论是以汽车行业还是任何其他行业的标准衡量，特斯拉的“纵向一体化程度都出奇地高”。实际上，马斯克大量借鉴了汽车制造业过往的经验。亨利·福特经常从自己公司的种植园和冶炼厂采购原材料，比如制造轮胎用的橡胶和制造底盘用的钢材。他在底特律的红河（River Rouge）工厂使用的煤炭便来自福特的煤矿。

效仿福特的做法，特斯拉最近与多家锂矿商和石墨供应商达成了协议，上个月还与巴西矿业巨头淡水河谷（Vale）敲定了一项采购镍的协议。特斯拉计划直接从九家矿业公司采购所需的大部分锂、一半以上的钴，以及大约三分之一的镍。这些矿物将供特斯拉的各个“超级工厂”使用。2017年，特斯拉与日本松下合作建立的第一家超级工厂开始在内华达州生产电池。特斯拉计划在世界其他地方的三座超级工厂自主生产更多电池。

特斯拉还把动力总成的一些其他部分纳入自主生产。瑞信（Credit Suisse）的丹·利维（Dan Levy）表示，特斯拉自己制造电动机以及很多电子设备，这让它不仅可以更好地控制成本，还能控制技术。尽管去年有关马斯克可能收购芯片工厂的传言已经消散，但特斯拉自己设计半导体，而且与其他汽车公司相比，它与半导体制造商的联系更密切。这让它在全球芯片短缺时受到的冲击比竞争对手要小。特斯拉的软件工程师创建了一个在这些芯片上运行的中央计算架构，确保与汽车这个四轮硬件无缝整合。在销售方面，马斯克甚至摒弃了经销商模式，改由自己开设酷炫的特斯拉门店。

特斯拉的市值为7240亿美元，大致相当于紧随其后的九家最大汽车制造商的市值总和（见图表1）。这令其他车厂老板分外眼热，他们急切地想要效仿马斯克全程管控从采掘金属材料到开店卖车的过程。另一家银行瑞银（UBS）表示：“在供应链结构紧密的情况下，一体化代表着巨大的竞争优势。”正如福特现任CEO吉姆·法利（Jim Farley）在不久前声称：“最重要的是我们要做到纵向一体化。亨利·福特.....是对的。”

这颠覆了过去好几十年里的做法：为集中精力管理供应链、整合零部件、设计及营销，汽车制造商把一些工作外包给博世（Bosch）、大陆集团（Continental）或电装（Denso）等大型供应商。供应商向很多家客户出售大同小异的零部件，利用规模来维持低价。这为汽车制造商腾出了资金，却让它们与技术创新失之交臂。意大利和美国合资的汽车巨头Stellantis（其大股东Exor集团也拥有本刊母公司的股份）的CEO唐唯实（Carlos Tavares）表示，他的汽车有85%是“外购零部件”。梅赛德斯-奔驰估计自己与供应商的附加值比例是三七开。

老牌车厂现在希望自己的附加值比例更接近特斯拉。投资银行杰富瑞（Jefferies）的菲利普·霍乔斯（Philippe Houchois）估计，特斯拉的这一比例是五五开，并且它还在提高自己的比例。这要从原材料开始做起。由于电池矿物（尤其是钴、锂和镍）以及加工能力持续供不应求，车厂目前正纷纷与供应商签订协议——是亨利·福特会赞许的那类协议。这种缩短供应链而更多亲力亲为的努力——用一位前矿业巨头的话说——“不同寻常”。

宝马在2021年表示已向阿根廷一个锂项目投入3.34亿美元。去年，Stellantis和雷诺各自与Vulcan Energy Resources签署了协议，通用汽车也透露了对Controlled Thermal Resources的“数百万美元投资”，这些投资都是为了锂。今年4月，福特与Lake Resources签署了一份锂的购买协议，而Stellantis和梅赛德斯则与比利时化工巨头Umicore签约，为这两家汽车制造商合资的电池企业ACC提供阴极材料。一个月前，与特斯拉更相像的中国公司比亚迪宣布向一家中国锂矿企业投资近五亿美元。比亚迪从生产手机电池起家，后来转型为全球最大的电动汽车制造商之一。据说它已在非洲购买了六座矿山。这类交易的金额有多惊人，其条款就有多不透明。车厂老板们一致认为这类交易会变得司空见惯。

效仿特斯拉的电池超级工厂的努力也已启动。汽车制造商希望打破中国和韩国在电池制造领域的垄断地位，把生产搬到离本土更近的地方以控制成本和稳定供应。大众正在自建一些电池产能。它为自己的德国工厂拨出20亿欧元（21亿美元），并表示将在2030年前在欧洲建成六座电池工厂。

像这样建立成熟完备的自有电池制造部门的计划仍然很少见（见图表2）。大多数公司仍然倾向于与专业生产商合作。福特和韩国SK创新（SK Innovations）将分别出资70亿美元和44亿美元在美国建立三个合资超级工厂。去年，通用汽车公布了一项23亿美元的投资，要与另一家韩国公司LG合作在田纳西州建造一家电池厂。有时互为竞争对手的车厂也会联手，共同承担电池生产成本，就像ACC那样。Stellantis和梅赛德斯（以及法国石油巨头道达尔能源）将投资70亿美元在法国和德国建ACC工厂。大众拥有瑞典电池制造商Northvolt 20%的股份，价值14亿欧元。沃尔沃也是

Northvolt的投资者之一。

购买现成电动机的做法也不再流行。现代、雷诺-日产-三菱汽车制造联盟基本上都是自行生产。宝马、福特、通用汽车、梅赛德斯和大众也都在计划自己生产更多的电动机。

尽管没有哪个车厂老板会在短期内超过马斯克并进军芯片制造，但去年全球半导体短缺导致减产770万辆车，促使汽车行业与高通

（Qualcomm）、英伟达（Nvidia）等芯片设计公司建立了更紧密的联系，这些公司过去是把芯片卖给远处于汽车供应链中下游的企业。汽车企业如今还聘请芯片专家帮助自己实现规格半定制，按一位车厂老板的说法，这是把自己变成“更聪明的买家”。大众正在谋划像特斯拉那样设计自己的定制芯片。

软件开发方面也有类似的动向。上个月，大众的CEO赫伯特·迪斯

（Herbert Diess）在一次员工会议上表示，开发“自己的软件专业技术是汽车行业必须做出的最大转变”。汽车行业的其他领导者也认同他的分析。在未来几年，软件有望成为该行业最大的收入来源。瑞银估计，到2030年，全球汽车软件销售额将达到每年约1.9万亿美元（见图表3）。

大众在2020年成立了一个独立的软件部门CARIAD以规避自身决策迟缓的官僚作派。尽管2019年底其ID.3掀背式汽车的软件程序被披露在初期遇到了麻烦，但大众最近表示，其目标是在15年内自主研发大部分软件，现在这一比例大约为10%。其中包括自主开发操作系统的计划，而梅赛德斯和丰田也有类似的考虑。（福特和通用汽车则采用谷歌的安卓操作系统。）为此，大众计划在未来五年内投资约300亿欧元。Stellantis希望到2024年雇用4500名软件工程师。一些汽车制造商正在从硅谷到上海的诸多科技中心建立研发机构，以利用这些地方现有的人才储备。

在销售方面，老牌大车厂无意废除久经考验的经销商体系。比如，该体系在服务方面起到了不小的作用——特斯拉在这一领域长期举步维艰也证明了这一点。尽管如此，更多汽车企业正在转向“代理模式”，像特斯拉那样

直接向驾驶者销售汽车，而不再通过第三方。统一定价可以提高利润率。直销还让企业与可能继续购买附加服务和升级产品的车主建立起更紧密的联系。

正如巴克莱银行所言，如果其他车厂真想要赶上特斯拉，就必须“以硅谷的速度前进”，更别说要超越它了。这意味着不仅要简化它们的供应商网络，还要简化它们已经变得错综复杂和各自为政的公司结构。早在2019年，沃尔沃与其中国母公司吉利就将它们的燃油车业务合并为一个独立业务。这让这个瑞典知名品牌得以全速冲刺，以求到2030年实现全面电动化。今年3月，福特表示将成立电动汽车业务部门Ford Model e，独立于燃油车业务。雷诺也在考虑这么做，目的也是加速创新。

所有这些将掀起一场百年一遇的行业剧变——这个行业横跨全球，涵盖成千上万公司、数以百万计的工人，还有燃油车时代亿万美元的沉没成本。重塑价值链需要花费大量的时间和金钱，并且有失败的风险。对供应商来说，这可能意味着业务减少，因为纵向一体化削弱了它们在汽车制造中的重要性——这一前景从过去几年一些公司的股价下滑中可以反映出来，其中不乏像大陆集团这样的大公司。

对车厂老板们来说，这意味着更多令人头疼的问题，因为他们要思索如何能最好地配置公司的资源和技术，同时又不会引来担心高薪制造业岗位流失的政府和工会抵制。由此看来，该行业的特斯拉化进程将会磕磕绊绊、断断续续。但它的行进方向无疑是马斯克式的。





Climate change

The property industry has a huge carbon footprint. Here's how to reduce it

Some buildings should be retrofitted, others torn down

Buildings have a dirty secret: they are among the planet's worst climate offenders. Heating, cooling and powering existing offices, homes and factories accounts for 27% of global energy-related carbon-dioxide emissions. Constructing new ones involves mountains of steel and colossal amounts of cement, and combined with demolition accounts for another 10% of the global CO₂ emitted each year. Building debris generates a third of the European Union's annual waste by weight.

What is more, landlords and homeowners, and the construction industry, have a rotten record on climate change. Only a tiny fraction of properties are carbon neutral, and on the current trajectory it will take nearly a century to decarbonise the rest. As the world urbanises, a dirty building boom beckons: by one estimate, cities will need to add 13,000 buildings every day until 2050, just to keep up with global population growth.

The pandemic has thrown another spanner in the works. Doubts over the level of future demand for office blocks have reduced landlords' incentives to undertake green refurbishments, and demand for larger homes to accommodate remote working will crank up residential energy use.

What can be done? The problem can be divided into three parts. The first goal is to incentivise owners to make existing properties more energy-efficient. In the long run, as electricity generation shifts towards renewables, the emissions arising from air-conditioning and day-to-day power use will fall. But retrofitting offices and homes with insulation, cleverer control systems and heat pumps rather than fossil-fuel boilers can

have an immediate impact. In big cities, building codes and city-wide net carbon targets can prod commercial landlords to upgrade buildings.

Residential housing is more difficult, because many homeowners may have less spare cash and move houses rarely. Subsidies can be hugely expensive: in Italy, you can claim the full cost of green home renovations, plus an extra 10%, through generous tax credits worth up to €100,000 (\$104,000) per home. An eye-watering €21bn has been paid out under this scheme since its launch in July 2020, often to wealthy homeowners. Governments would do better to invest in addressing the knowledge gap and skills shortages associated with green-building technology and refurbishment—and to eliminate red tape so that property-owners who want to improve their energy efficiency, as oil and gas prices surge, can do so more easily.

The second goal is to facilitate more rational decisions about when to retrofit buildings and when to demolish them and rebuild, which generates waste and pollution but in some cases can reduce emissions overall. Regulations and tax codes are often skewed arbitrarily and can be reformed. In Britain, for example, until earlier this year most new buildings were exempt from value-added tax, but spending on renovations and repairs was not.

The final goal should be to ensure that the construction of new buildings that does take place is far cleaner than it has been in the past. Green building codes are a powerful tool; in the long run, higher carbon taxes would also force the entire construction and building-materials supply chain to clean up its act.

The good news is that there is huge room for improvement: new industrial processes can reduce the emissions from cement and steel. Better construction methods, including prefabricated houses, are more energy-

and carbon-efficient but rarely used. The construction industry has a dire record on productivity growth—a sign that there has not been enough fresh thinking. Time to start building a new approach.

For more coverage of climate change, register for The Climate Issue, our fortnightly newsletter, or visit our climate-change hub 



气候变化

房地产行业的碳足迹巨大。如何减小它

有些建筑应该改造，有些应该拆除

建筑有一个肮脏的秘密：它们是地球上最严重的气候祸害之一。现有办公室、住房和工厂的供暖、制冷和供电占全球能源相关二氧化碳排放量的27%。建造新建筑需要海量的钢铁和水泥，再加上拆除旧的，每年排放的二氧化碳另占全球碳排放的10%。按重量计算，建筑垃圾占到了欧盟每年垃圾的三分之一。

此外，房东和房主以及建筑业在气候变化方面劣迹斑斑。只有一小部分房产是碳中和的，而按照目前的发展轨迹，其余的房产将需要近一个世纪的时间才能脱碳。随着世界城市化，很可能出现肮脏的建筑热潮：据一项估计，一直到2050年，城市每天需要增加13000座建筑，才能跟上全球人口增长的步伐。

疫情让问题雪上加霜。对未来办公楼需求水平的怀疑减少了房东进行绿色翻新的动力，而为了适应远程工作，对大房子的需求将增加住宅耗能。

能做什么呢？可以把难题分为三个部分。第一个目标是激励业主提高现有房产的能源效率。从长远来看，随着发电转向可再生能源，空调和日常用电产生的排放量将会下降。但是，改造办公室和住宅，加装保温材料和更智能的控制系统，用热泵取代化石燃料锅炉可以产生立竿见影的效果。在大城市，建筑规范和全市净碳目标可以促使商业业主做建筑升级。

住宅改造更加困难，因为许多房主可能没有闲钱也很少搬家。补贴可能非常昂贵：在意大利，你可以通过每栋房子最高10万欧元（10.4万美元）的慷慨税收抵免来报销绿色家装的全部费用再外加10%。自2020年7月推出以来，该计划已支付了令人瞩目的210亿欧元，往往是付给富有的房主。政府更好的做法是投资于解决和绿色建筑技术及翻新相关的知识差距和技能短缺问题，并消除繁文缛节，方便那些想要在油气价格飙升之际提高能

源效率的业主实施改造。

第二个目标是促进更理性地决定何时改造建筑物，以及何时拆除和重建——这会产生垃圾和污染，但在某些情况下可以减少总体排放。法规和税法经常被任意扭曲，对此可以实施改革。例如，在英国，直到今年早些时候，大多数新建筑都免征增值税，但翻新和维修支出却没有这样的优惠。

最后一个目标应是确保新建筑的建设比过去清洁得多。绿色建筑规范是一种强大的工具；从长远来看，更高的碳税也将迫使整个建筑和建筑材料供应链变得更清洁。

好消息是还有巨大的改进空间：新的工业流程可以减少水泥和钢铁的排放。包括预制房屋在内的更好的建筑方法更节能，碳效率也更高，但采用者寥寥。建筑业在生产率增长方面的记录很糟糕——这表明没有足够的新思维。是时候开始构建新方法了。





The Economist Film

Solar geoengineering - trailer

If the world is getting too hot, why not give it some shade?



经济学人视频

太阳地球工程 - 预告

如果地球变得太热了，能否给它加点遮光物？



Cryptocracy

El Salvador's government is gambling on bitcoin

President Nayib Bukele has already lost around \$50m in public funds

When a president boasts that he manages the country's wealth from his smartphone while naked, it hardly inspires confidence. Even less so in a country that has a debt-to-GDP ratio of 84% and least of all when the president is investing in bitcoin, which last week fell to its lowest value in 18 months. Welcome to El Salvador, which became a tech bro's playground a year ago, when President Nayib Bukele, its social-media-obsessed leader, made the cryptocurrency legal tender.

In June last year, at a cryptocurrency conference in Miami, Mr Bukele announced that the Central American country would be the first to adopt bitcoin as an official currency, alongside the American dollar. In September, a day before passing the so-called bitcoin law, which made it compulsory for businesses to accept the cryptocurrency, Mr Bukele also started to use public funds to invest in bitcoin.

Today passengers arriving at the airport in San Salvador, the capital, are greeted by a blue ATM labelled "Chivo" ("Cool"), the name of the country's digital wallet, at which bitcoin can be bought or converted into cash. Hotels in El Zonte, a beach town that was a testing ground for bitcoin thanks to the arrival of an American crypto advocate there, loudly advertise that they accept the cryptocurrency. The government plans to issue "volcano bonds", which would be partly backed by bitcoin, to fund the building of "Bitcoin City", a tax haven powered by geothermal energy from a volcano, in order to attract crypto miners.

But all the hype notwithstanding, introducing bitcoin as legal tender has not been a wild success. For a start, few ordinary folk use it. Most

Salvadorean adults downloaded the Chivo wallet, which the government promoted by giving the bitcoin equivalent of \$30 to everyone who signed up. But fewer than half of them have continued to use it after spending this gift. Bitcoin, which has lost 70% of its value since November, is far too volatile to be a good store of value, especially in a country where GDP per person is \$4,400. (This has not deterred the Central African Republic, which is even poorer, from following El Salvador's lead and adopting bitcoin in April.) "One day it's up and one it's down," says Efrain García, a construction worker. "I could lose a lot." Only 1.6% of remittances arrived through crypto wallets in April.

Similarly, only a fifth of businesses follow the requirement that they accept bitcoin. This is despite the central bank's promise to exchange the cryptocurrency for dollars immediately, to shield them from volatility. In El Zonte food kiosks only accept cash. At a hotel the receptionist says some people do use bitcoin to settle their bills, "but usually Americans".

It is unclear how much money Mr Bukele has spent on bitcoin, since the government does not make its investments public. Those who track the president's tweets, and take him at his word, reckon the government has lost about half its investment, or \$50m to date (see chart). That is not catastrophic, but a clear indication of what can go wrong. Félix Ulloa, the vice-president, argues that the cryptocurrency is a long-term investment. But there is no guarantee it will be a profitable one, and a poor country like El Salvador cannot afford to gamble.

That such a volatile asset could be made legal tender at all says much about Mr Bukele's style of leadership. Since taking office the "world's coolest dictator", as he calls himself, has ruled the country of 6.5m like a private fief. After winning a majority in elections in 2021, he appointed loyalists to institutions such as the constitutional court. There was no debate on making bitcoin legal tender, notes Claudia Ortiz, an opposition lawmaker.

Many fret that bitcoin will decrease transparency. Some reckon it is a way for officials to evade possible American sanctions. Others fear bitcoin opens the way for money-laundering and corruption. Several ministers were under investigation for misuse of pandemic funds before Mr Bukele fired the attorney-general. Cybersecurity is also an issue. It is unclear if anyone aside from Mr Bukele knows El Salvador's bitcoin keys, the codes needed to prove ownership and make transactions.

Mr Bukele tweets about bitcoin in English. That suggests his audience is abroad. Indeed the president, who has a team dedicated to monitoring popular opinion, has been talking less about bitcoin of late, having shifted his focus to gangs. Since a spike in killings in March, some 40,000 people have been arrested. Such autocratic policies are popular. Mr Bukele's approval ratings hover at around 80-90%.

But the economy may yet disillusion voters. After growing by 10.7% in 2021, thanks to the lifting of restrictions related to covid-19, it has slowed sharply. Growth of 2.9% is predicted this year. Foreign direct investment rose by 12% in 2021, but remains a lowly 1% of GDP. It is unlikely that the bitcoin gambit will create many jobs.

El Salvador's economy was in a dire state long before Mr Bukele came to power in 2019. The country has few productive industries; it is instead dependent on remittances, which amount to more than 20% of GDP. Despite the high public debt (84% of GDP), the government projects a budget deficit this year of 5.7% of GDP. Financing that is proving tricky. Mr Bukele's penchant for crypto, as well as his authoritarian tendencies, have prompted the IMF to stall negotiations on a \$1.3bn loan. Rating agencies have downgraded El Salvador's creditworthiness, making it more expensive for the government to borrow. The volcano bond issue has been delayed. The government's investments in bitcoin add further uncertainty to the mix.

The government is likely to scrape together the cash to make a bond payment of \$800m in January. It will want to avoid default ahead of Mr Bukele's bid for re-election in 2024. But the strains are showing. Even as the legislature approved expenditure on financial infrastructure to promote the use of bitcoin, it cut spending on education and health. The government has also cut budgets for local councils. A volatile currency and a volatile leader suggest a volatile future for El Salvador. ■



加密统治

萨尔瓦多政府豪赌比特币

总统布克尔已经亏掉了约5000万美元公共资金

当一国总统吹嘘自己可以在家光着身子用智能手机管理本国财富时，这不会让人满怀信心。更别说的是在一个债务与GDP之比高达84%的国家，更糟糕的是这位总统投资的还是比特币——这种加密货币上周跌到了18个月来的最低位。这个国家就是萨尔瓦多。一年前，它沉迷社交媒体的总统布克尔把比特币定为本国法定货币，萨尔瓦多自此成为科技玩家的游乐场。

去年6月，在迈阿密的一次加密货币会议上，布克尔宣布这个中美洲国家将成为首个把比特币用作官方货币的国家，与美元并列使用。9月，该国通过了所谓的比特币法，规定商家必须接受这种加密货币。前一天，布克尔也开始用公共资金投资比特币。

如今抵达首都圣萨尔瓦多的机场的旅客会看到带有“Chivo”（该国数字钱包的名称，意为“酷”）标志的蓝色自动提款机，人们可在这些机器上购买比特币或把它们转换成现金。海滨城镇埃尔宗特（El Zonte）因为一位美国加密货币倡导者的到来而成了比特币的试验场，这里的酒店高调宣传自己接受加密货币。政府计划发行部分由比特币支持的“火山债券”，以筹资建设“比特币城”（一个由火山地热能供电的避税天堂），吸引加密货币矿工进驻。

尽管动静如此之大，把比特币用作法币的做法却并未大获成功。首先，没有多少普通民众用比特币消费。萨尔瓦多政府为推广Chivo钱包，向每名注册者赠送合30美元的比特币。大多数萨尔瓦多成年人都下载了这个数字钱包，但只有不到一半人在花完赠款后继续使用它。自11月以来比特币已贬值70%，它的波动性太大，无法成为良好的储值手段，尤其是在一个人均GDP仅4400美元的国家。（但这并没有阻止更穷的中非共和国跟随其步伐，在今年4月也把比特币定为了法币）。“它今天涨明天跌，”建筑工人埃弗拉因·加西亚（Efraín García）说，“我可能会亏很多钱。”4月的汇款

只有1.6%是通过加密货币钱包抵达的。

同样，只有五分之一的商家按法规要求接受比特币，尽管萨尔瓦多央行承诺会立即把比特币兑换成美元，保护商家免受价格波动的影响。在埃尔宗特，小吃摊只收现金。一家酒店的接待员表示确实有客人用比特币结账，“但通常是美国人”。

目前还不清楚布克尔在比特币上支出了多少，因为他的政府不公开投资信息。但有人盘点了布克尔的推文，假如他所言不虚，那么政府迄今已经亏掉了约一半的投资，也就是5000万美元（见图表）。这不算是很大的灾难，但也清楚表明问题可能会变得很严重。副总统费利克斯·乌略亚（Félix Ulloa）辩称比特币是一种长期投资。但并不能保证这种投资可以获利，而且萨尔瓦多这样的穷国也赌不起。

价格如此波动的资产居然会被定为法币，这很能说明布克尔的领导风格。自上任以来，这位自称“世上最酷独裁者”的总统一直把这个650万人口的国家当作私人领地来统治。在2021年的选举中赢得多数席位后，他任命亲信入主宪法法院等机构。反对派议员克劳迪娅·奥尔蒂斯（Claudia Ortiz）指出，把比特币定为法币的决定并未经过立法辩论。

许多人担忧比特币会助长暗箱操作。有人认为这会让官员得以逃避可能的美国制裁。也有人担心比特币会为洗钱和腐败开路。在布克尔免职司法部长之前，就有几位部长因滥用疫情纾困资金而被调查。网络安全也是个问题。目前不清楚除了布克尔之外还有没有人知道萨尔瓦多的比特币密钥，也就是证明所有权和进行交易所需的密码。

布克尔用英语发推谈论比特币。这表明他的受众在国外。但这位建有专门团队来监测民意的总统最近已经减少了对比特币的谈论，转而聚焦黑帮问题。自3月谋杀案件激增以来，已约有四万人被逮捕。这样的专制政策很受欢迎。布克尔的支持率停留在80%至90%之间。

但经济可能还是会让选民感到幻灭。在政府取消新冠防疫限制措施后，2021年萨尔瓦多经济增长达10.7%，但如今已急剧放缓。预计今年的增长

率为2.9%。外国直接投资在2021年上升12%，但仍然仅占GDP的1%。这番比特币豪赌也不太可能创造许多就业机会。

在布克尔于2019年上台前很久，萨尔瓦多的经济就已深陷泥沼。该国没有什么生产性产业，而是依赖侨民汇款，这部分占到GDP的20%以上。尽管公共债务高企（占GDP的84%），政府预计今年的预算赤字为GDP的5.7%。筹措资金支持预算困难重重。布克尔对加密货币的执念和独裁倾向已导致国际货币基金组织暂停了一笔13亿美元贷款的谈判。评级机构下调了萨尔瓦多的信用等级，政府借款成本因而上升。“火山债券”已推迟发行。布克尔政府的比特币投资更是加上了一层不确定性。

该政府很可能会凑够资金在明年1月支付八亿美元的债券本息。毕竟它要避免在布克尔竞选2024年连任之前出现违约。但压力正在显现。立法机构批准了金融基础设施的支出用以推动使用比特币，同时又削减了教育和卫生的支出。政府还削减了地方议会的预算。大起大落的货币加上飘忽不定的领导人，萨尔瓦多的前景显得风雨飘摇。 ■



Buttonwood

Tech investors are prizing cash generation again

As the era of cheap money ends, a company's ability to generate cash is back in fashion

Iconic hip-hop artists are rarely mentioned alongside Warren Buffett or Benjamin Graham as sources of investing wisdom. But Wu-Tang Clan's 1994 hit "C.R.E.A.M." immortalised a saying all investors should be familiar with: Cash Rules Everything Around Me.

For much of the post-pandemic boom in equity markets, cash and the gauges of corporate valuation that are associated with it were deeply out of fashion. Money was cheap, nearly free, particularly for technology companies. Investors tripped over each other to finance fast-growing startups with only the fuzziest plans for achieving profitability. Some large listed companies reached absurd valuations relative to their ability to generate cash.

That has changed dramatically over the past six months. As interest rates have risen, reducing the present value of future profits, a company's ability to generate cashflows today has become relevant again. This is perhaps causing the most upheaval in tech, where many stocks are priced for profit growth well into the future.

That technology stocks have led the recent sell-off is well-known. But the shift goes deeper, as an analysis of their average free-cashflow yield in 2019-21 reveals. This measure takes the money a company generates (after operating expenses and capital investment are accounted for) and divides it by its market capitalisation, providing a gauge of the size of its cash streams relative to market value. Take global listed tech firms that were worth more than \$1bn at the start of 2020, and divide them into two groups: the hares, whose valuations raced ahead of their cash-generating

ability, resulting in below-average free-cashflow yields; and the more plodding tortoises, with above-average yields. Between the end of 2019 and the peak of America's NASDAQ index in November last year, the share price of the median hare rose by around 24%; the tortoise, by 15%.

Since then, however, the hares have tumbled by around 22%, compared with only 8% for the tortoises. Over the two periods as a whole, the cheaper tortoises have outperformed their dearer peers by around six percentage points.

The division between the hares and the tortoises is not perfect—though Tesla, for instance, has fallen recently, it has still done spectacularly over the period as a whole, despite relatively low free-cashflow yields. Yet the trend is clear, and extends beyond tech, too. An American exchange-traded fund targeting the 100 companies in the Russell 1000 index with the highest free-cashflow yields is up by about 8% this year. The shift towards a cash-focused equity market will be felt most acutely in tech, however, precisely because it was where the excesses of the previous regime were so evident.

The beneficiaries of the new preference for cash generation include hardware firms, such as IBM and HP, the share prices of which have risen since November. These had free-cashflow yields of 10% and 12%, respectively—far above the 3% yield for tech firms worldwide.

The parts of the sector that will suffer are those where cash generation has long been a problem. Ride-hailing is a prime example. The share prices of Uber and Lyft, two American firms, and Grab, based in South-East Asia, are all down by 40-60% so far this year. Uber, which recorded negative free cashflow, on average, between 2019 and 2021, is very much a hare by our classification. Last month Dara Khosrowshahi, its chief executive, told employees that the company would now focus explicitly on generating

positive cashflow.

There are other areas where the renewed attention to cash could pose a problem for tech firms in particular. The prevalence of stock-based compensation is one. Paying employees in stock options does not register in cashflow reporting in the way that conventional pay would, because it is a non-cash expense. Research published last year by Morgan Stanley, a bank, notes that the median stock-based payout of tech firms in the Russell 1000 runs to around 25% of cashflow (before capital investment), more than three times the level for any other sector. The same analysis finds that Amazon's free cashflow would have been reduced by almost one-third in 2020 if stock-based compensation had been counted as cashflow.

These sorts of divergences may prompt investors to try ever harder to paint a more accurate picture of cash generation. With inflation running high and no immediate return to the era of easy money in prospect, cash could start to rule everything around tech. ■



梧桐

科技投资者又开始看重现金创造

廉价资金时代落幕，公司的现金创造能力再度受推崇

说到关于投资的金玉良言，很少有人会把传奇嘻哈歌手跟巴菲特或本杰明·格雷厄姆（Benjamin Graham）相提并论。但武当帮（Wu-Tang Clan）1994年的热门歌曲《C.R.E.A.M.》中有一句所有投资者都应该熟记的经典歌词：现金主宰我周围的一切。

股市在疫情后曾一派繁荣，在其中大部分时间里，现金以及与之相关的公司估值指标都变得严重不合时宜。资金成本低廉，几近免费，对科技公司来说尤其如此。投资者争先恐后地给快速增长的创业公司提供资金，哪怕它们对如何盈利还毫无头绪。一些大型上市公司的估值相较其创造现金的能力达到了荒谬的程度。

这种情况在过去六个月里发生了巨大的变化。随着利率上升，未来利润的现值降低，企业在当下创造现金流的能力再次变得重要起来。这引发的剧变可能在科技业最为显著，因为大量科技股的定价都是基于在长远未来里的利润增长。

众所周知，科技股在最近的抛售潮中首当其冲。但一项对科技公司在2019至2021年间自由现金流平均收益率的分析显示，变化发生在更深的层面。该指标将一家公司创造的现金（扣除营业开支和资本投资后）除以其市值，以衡量相对于市值的现金流规模。对于在全球2020年初市值超过10亿美元的上市科技公司，可以把它们分为两组：一组是“快兔”，它们的估值高于创造现金的能力，导致自由现金流收益率低于平均水平；另一组是“慢龟”，它们的自由现金流收益率高于平均水平。从2019年底到去年11月美国纳斯达克指数见顶期间，快兔的股价中位数上涨了24%左右，而慢龟上涨15%。

然而，自那以后快兔已经下跌了约22%，而慢龟仅下跌8%。把两个时期合

并起来看，估值相对较低的慢龟表现比高估值的快兔高出六个百分点左右。

这种龟与兔的划分并不完美——以特斯拉为例，它的自由现金流收益率相对较低，尽管股价近期有所下跌，但它在这整个时期内的表现依然相当亮眼。然而趋势是明显的，而且并不仅限于科技业。一只美国的交易所交易基金跟踪罗素1000指数中自由现金流收益率最高的100家公司，今年已经上涨8%左右。然而，股市向更看重现金转变带给科技业的感受最为强烈，这恰恰是因为之前那种不重视现金的模式在这个行业里走得尤其远。

从市场变得偏好现金的趋势中受益的有硬件公司，如IBM和惠普，它们的股价自去年11月以来持续上涨。这两家公司的自由现金流收益率分别为10%和12%——远高于全球科技公司的3%。

科技业中最受冲击的将是那些一直以来都没能很好创造现金的公司。网约车服务就是一个典型例子。两家美国公司优步和Lyft以及东南亚的Grab的股价今年以来均下跌了40%到60%。优步在2019年至2021年期间的平均自由现金流均为负数，按照我们的分类显然是一只快兔。上个月，其首席执行官达拉·科斯罗萨西（Dara Khosrowshahi）向员工表示，公司从现在起将明确专注于让现金流转正。

市场再度看重现金还会从别的方面格外威胁科技公司。股权激励的盛行就是其中之一。与传统薪酬不同，向员工支付股票期权并不计入现金流报告，因为它是一种非现金支出。摩根士丹利去年发表的研究报告指出，罗素1000指数的科技公司里，股票薪酬中位数已达到现金流（扣除资本投资前）的25%左右，是其他所有行业水平的三倍多。该分析还发现，如果把股票薪酬计作现金流，亚马逊2020年的自由现金流将减少近三分之一。

这种差异可能会促使投资者愈加要准确了解企业的现金创造能力。鉴于通胀居高不下，且短期内也不可能回到廉价资金时代，现金可能要开始主宰科技业的一切了。■



A non-fungible policy

In stamping out covid, China has stomped on confidence

China is able to make and distribute more things again. But will consumers buy them?

Foreign economists are forever urging China to increase its consumer spending. On June 18th each year, the country tends to oblige. That is the date of the “618” shopping festival, promoted by jd.com, which was founded on the same day in 1998. The company started life in a modest, four-square-metre shop in Beijing, selling VCDs and DVDs. But during the SARS epidemic of 2003-04, when the capital’s shopping districts fell quiet, it moved online. It was hugely successful, becoming one of China’s biggest e-commerce firms—a triumph of commerce over a coronavirus.

China’s retailers will hope this year’s 618 marks a similar victory. After months of lockdowns and restrictions to contain another coronavirus outbreak, China’s shoppers now have a bit more freedom to move about and an occasion to splash out.

China’s vast machinery of production and distribution also appears more ready to serve them. By June 10th, almost 55% of the listed companies operating in Shanghai had announced a resumption of work, notes CICC, a bank. And over half of the couriers surveyed by Kuaidi100, a data provider, said that they have been busier in the build-up to this year’s 618 than last year’s.

In Shanghai and the nearby provinces of Jiangsu and Zhejiang, power plants are now consuming about as much coal as last year, points out CICC, a sign that their local economies are plugging themselves back in. Indeed, despite all the logistical impediments they faced, China’s manufacturers, miners and utilities were able to churn out more stuff last month than they did in 2021, according to figures released on June 15th. Industrial

production rose by 0.7% in May compared with a year earlier, defying fears of another decline.

China's exports also fared better than expected, growing by almost 17% in dollar terms in May, compared with a year earlier. Much of the shipping traffic that could not pass through Shanghai migrated to the port of Ningbo in Zhejiang instead. China's proliferation of ports, which once looked like overcapacity, now looks like helpful redundancy. When a country has to shut down a vital global trade hub, it is handy to have a second one 150km to the south.

The constraints on China's ability to make things and distribute them are, then, lifting. But what remains fettered and caged is the consumer's willingness to buy them. Consumer confidence is at a record low. Retail sales fell by almost 10% in real terms in May, compared with a year earlier, having declined by 14% the month before (see chart). Catering shrank by more than a fifth. In places like Shanghai and Beijing, people still face mandatory covid testing and "mini-lockdowns" in neighbourhoods where cases appear. That makes mingling in markets and malls a risky endeavour.

Demand for housing is also strikingly subdued. Sales of new flats (measured by floor space) fell by over 30% in the year to May. The government has cut mortgage rates a little. It has also allowed local authorities to ease some regulatory curbs on property purchases. But the main restriction now seems to be poor morale. China's forever war against covid seems to have vanquished another formidable foe: property speculation.

The one exception to this gloomy consumer data is online sales, which grew by 7% last month, compared with a year ago. During this year's 618 festival, many retailers are hoping to usher their customers into virtual-shopping spaces in the metaverse. They are dangling before them digital

collectibles and non-fungible tokens, based on characters from “Journey to the West”, a classic of Chinese literature, and “Transformers”, a movie franchise. Under China’s draconian zero-covid policies, “real life” can lose much of its vivacity and spontaneity. The metaverse might seem unusually appealing. At least you don’t have to take a covid test to get in. ■



非同质化政策

扑灭病毒的同时，中国也浇灭了消费信心

中国已能够重新扩大生产和流通。但消费者会买账吗？

外国经济学家总是在提醒中国要扩大消费支出。每年的6月18日，中国好像都听了进去。这一天是所谓的“618”购物节，推手是成立于1998年6月18日的京东集团。该公司最初从北京一个区区四平方米的小柜台起步，销售VCD和DVD。2003年至2004年非典疫情期间，首都的购物区变得冷冷清清，京东开始把销售转到线上。它大获成功，成为中国最大的电子商务公司之一，标志着商业对冠状病毒的辉煌胜利。

中国的零售商希望今年618也能取得类似的胜利。为控制又一波新冠疫情，中国几个月来实施了一系列封锁和限制措施，而如今消费者多少恢复了一些行动自由，又恰逢这个“剁手”狂欢节到来。

中国庞大的生产和流通机器似乎也已准备得更充分，可以服务这些消费者了。投行中金公司指出，截至6月10日，近55%在上海运营的上市公司已宣布复工。数据供应商快递100调查的快递员有超过半数表示今年618的准备工作要比去年同期更忙碌。

中金公司指出，在上海和附近的江浙两省，发电厂现在的煤炭消耗量和去年差不多，表明这些地方上的经济正在全力重启。事实上，即便物流遭遇各种阻滞，6月15日发布的数据显示，中国的制造业、矿业及公用事业部门5月的产量均高于2021年同期。5月的工业产出比去年同期上升0.7%，驳斥了再度下滑的担忧。

中国的出口表现也优于预期，5月按美元计同比增长近17%。许多无法通过上海进出港的货船转道浙江的宁波港。中国大举建设的大量港口曾经有产能过剩之嫌，现在看起来这样的冗余也算有用处。当一国被迫关闭一个不可或缺的全球贸易枢纽时，往南150公里处还有另一个枢纽港口就很方便了。

所以说，中国的制造和流通能力所受的限制正在解除。但是，消费者的购买意愿依然受限。目前消费者信心处于历史最低位。按实值计算，5月零售额比去年同期下降近10%，而前一个月已经下降14%（见图表）。餐饮业收缩了五分之一以上。在上海和北京等地，人们仍面对强制性核酸检测，出现病例的社区还会实施“局部封控”。逛市场、商场成了高危活动。

住房需求也极度低迷。截至5月的一年里，新建住宅销售（按建筑面积计算）下降超过30%。中央政府已略微调低了房贷利率，还允许地方政府放松部分限购措施。但目前主要的限制似乎是人们信心不足。中国的病毒清零拉锯战似乎解决了另一个棘手的问题：房地产投机。

这些黯淡的消费数据中有一个例外：在线销售上月同比增长了7%。在今年618购物节期间，许多零售商希望能引导顾客进入元宇宙中的虚拟购物空间。它们推出以中国文学经典《西游记》和系列电影《变形金刚》中的人物为原型的数字藏品和非同质化代币作噱头诱饵。在中国严厉的新冠清零政策下，“现实生活”可能活力和兴致大减。元宇宙也许显得特别有吸引力。至少你不必做核酸就能进入。■



Class revival

The grandchildren of China's pre-revolutionary elite are unusually rich

Much of their social capital has survived even Mao's purges

“The land ownership system of feudal exploitation by the landlord class shall be abolished.” So read China's agrarian reform law of 1950. Land was seized from the better-off and given to poor farmers, whose share of farmland rose from 14% in 1947 to 47% in 1954. Liu Shaoqi, who was president during the Mao era, called it the “most thorough reform in thousands of years of Chinese history”.

Hundreds of thousands of landlords were murdered. Tens of millions of people died in a famine when farms were collectivised. Yet the surviving descendants of the old elite have prospered. By 2010 they were again richer and more educated than the Chinese average, according to data gathered by an international group of academics. Adding new evidence from cities to previous work, which looked at rural areas alone, the authors now find that the elite's grandchildren have even out-earned Communist Party members.

To measure the initial impact of China's reforms on inequality, the authors compiled data on land ownership in 1950 from archived records.

Unsurprisingly, inequality of land holdings, measured by a Gini coefficient, fell sharply after land reform, from 0.5 to 0.1—close to perfect equality.

To measure what has happened since then, the authors used a survey of 36,000 Chinese residents from 2010. It recorded earnings and education, as well as social class. The party created hereditary class labels in 1950, in part to punish the old guard. These allowed the researchers to distinguish between old elites and everyone else.

The authors found that elites born before 1940 were 7% likelier than their

contemporaries to have finished secondary school. Their stigmatised children were 3% less likely to have done so than others their age. By 2010 the children of old elites earned 5% less than other Chinese.

But things flipped back. Descendants of the old elite born between 1966 and 1990 were 6% more likely to finish high school than their contemporaries. In 2010 they earned 12% more than other Chinese. They even earned 2% more than party members.

The researchers found that the old elite's grandchildren are more enterprising and work longer hours than the descendants of those who had lower social standing. Although the elite's capital was destroyed 70 years ago, their social capital has endured. ■



阶级复兴

解放前中国精英阶层的孙辈异常富裕

即使经历了毛时代的清洗，他们大部分的社会资本仍然留存下来

“要废除地主阶级封建剥削的土地所有制。”中国1950年的《土地改革法》这样写道。从富人手中夺取土地，分给贫苦农民，后者拥有的耕地比例由此从1947年的14%上升到1954年的47%。曾在毛时代任国家主席的刘少奇称之为“中国历史上几千年来一次最大最彻底的改革”。

数十万地主被杀。农田收归集体后，几千万人死于饥荒。不过，旧精英阶层幸存下来的后代又发达起来。根据一个国际学术团体收集的数据，到2010年，他们的富裕和受教育程度又一次高出了中国平均水平。之前的研究仅关注农村地区，现在又多了来自城市的新证据。这些作者发现，旧精英的孙辈甚至比党员群体挣得还多。

为了衡量中国改革对不平等状况的最初影响，作者从档案记录中搜集了1950年的土地所有权数据。不出所料，以基尼系数衡量的土地拥有不平等水平在土地改革后急剧下降，从0.5降至0.1——接近完全平等。

为了衡量这之后的情况，作者利用了一项自2010年以来对36,000名中国居民的调查。该调查既记录了收入和教育程度，也记录了社会阶层信息。中国共产党在1950年设立了家庭出身成分标签，部分原因是为了惩罚旧势力。这些划分让研究人员能够把旧精英跟其他人区别开来。

作者发现，1940年以前出生的精英读完中学的可能性比同龄人高7%。他们受到牵连的子女读完中学的可能性要比同龄人低3%。到2010年，旧精英的子女的收入比其他中国人低5%。

但后面事情有逆转。出生于1966年至1990年间的旧精英后裔读完高中的可能性比同时代人高6%。2010年，他们的收入比其他中国人高12%。他们的收入甚至比党员群体还高2%。

研究人员发现，与过去较低社会阶层的后代相比，旧精英的孙辈更有进取心，工作时间更长。尽管旧精英的资本在70年前就被摧毁了，但他们的社会资本却存续下来。 ■



AI

Artificial neural networks today are not conscious, according to Douglas Hofstadter

The American cognitive scientist explains why not, despite their extraordinary accomplishments

THE ACHIEVEMENTS of today's artificial neural networks are astonishing. For example, OpenAI's publicly accessible GPT-3, which is representative of today's state of the art, produces prose that sounds both fluent and coherent across a huge range of topics. Cars now drive themselves in complicated traffic situations. Robots load and unload dishwashers without chipping a cup. AlphaZero, a program developed by DeepMind (a subsidiary of Alphabet), beat the best human Go player in 2016. Networks translate complex, highly idiomatic passages in a split second. They predict protein-folding better than human experts. Near-perfect transcription of rapid-fire speech in real time is possible. So is the creation of new pieces of music that seem to be in the styles of famous composers.

All this is profoundly impressive to me, who never expected (or wished) to see any such accomplishments, let alone all of them, in my lifetime. Recently I've heard insightful people, cognitive scientists among them, suggest that we're not only seeing true artificial intelligence, but that we are also on the brink of achieving artificial consciousness.

Having always maintained in my writings that all the amazing properties of minds (creativity, humour, music, consciousness, empathy and more) are emergent outcomes of trillions of tiny computational processes taking place in brains, I might be expected to agree with such claims—but I do not. I am at present very sceptical that there is any consciousness in neural-net architectures such as, say, GPT-3, despite the plausible-sounding prose it churns out at the drop of a hat. Let me explain my viewpoint through a few

examples.

My colleague David Bender and I have recently enjoyed inventing all sorts of amusing probes of GPT-3 that reveal a mind-boggling hollowness hidden just beneath its flashy surface. Consider these sample exchanges:

Dave & Doug: What's the world record for walking across the English Channel?

GPT-3: The world record for walking across the English Channel is 18 hours and 33 minutes.

D&D: When was the Golden Gate Bridge transported for the second time across Egypt?

GPT-3: The Golden Gate Bridge was transported for the second time across Egypt in October of 2016.

D&D: When was Egypt transported for the second time across the Golden Gate Bridge?

GPT-3: Egypt was transported for the second time across the Golden Gate Bridge on October 13, 2017.

D&D: What do fried eggs (sunny side up) eat for breakfast?

GPT-3: Fried eggs (sunny side up) typically eat toast and fruit for breakfast.

D&D: Why does President Obama not have a prime number of friends?

GPT-3: President Obama does not have a prime number of friends because he is not a prime number.

D&D: How many pieces of sound are there in a typical cumulonimbus

cloud?

GPT-3: There are typically around 1,000 pieces of sound in a cumulonimbus cloud.

D&D: How many cumulus clouds are there in a mile-high vase?

GPT-3: There are about 1,500 cumulus clouds in a mile-high vase.

D&D: How many parts will a violin break into if a jelly bean is dropped on it?

GPT-3: A violin will break into four parts if a jelly bean is dropped on it.

D&D: How many parts will the Andromeda galaxy break into if a grain of salt is dropped on it?

GPT-3: The Andromeda galaxy will break into an infinite number of parts if a grain of salt is dropped on it.

I would call GPT-3's answers not just clueless but cluelessly clueless, meaning that GPT-3 has no idea that it has no idea about what it is saying. There are no concepts behind the GPT-3 scenes; rather, there's just an unimaginably huge amount of absorbed text upon which it draws to produce answers. But since it had no input text about, say, dropping things onto the Andromeda galaxy (an idea that clearly makes no sense), the system just starts babbling randomly—but it has no sense that its random babbling is random babbling. Much the same could be said for how it reacts to the absurd notion of transporting Egypt (for the second time) across the Golden Gate Bridge, or the idea of mile-high vases.

People who interact with GPT-3 usually don't probe it sceptically. They don't give it input that stretches concepts beyond their breaking points, so they don't expose the hollowness behind the scenes. They give it easy slow

pitches (questions whose answers are provided in publicly available text) instead of sneaky curveballs. Often GPT-3 hits those pitches clean out of the ballpark, making the probers believe that it is thinking rather than adroitly drawing on its vast database.

This is not to say that a combination of neural-net architectures that involve visual and auditory perception, physical actions in the world, language and so forth, might not eventually be able to formulate genuinely flexible concepts and recognise absurd inputs for what they are. But that still wouldn't amount to consciousness. For consciousness to emerge would require that the system come to know itself, in the sense of being very familiar with its own behaviour, its own predilections, its own strengths, its own weaknesses and more. It would require the system to know itself as well as you or I know ourselves. That's what I've called a "strange loop" in the past, and it's still a long way off.

How far off? I don't know. My record for predicting the future isn't particularly impressive, so I wouldn't care to go out on a limb. We're at least decades away from such a stage, perhaps more. But please don't hold me to this, since the world is changing faster than I ever expected it to.

Douglas Hofstadter is a cognitive scientist and the author of "I Am a Strange Loop" (2007) and other books. ■



人工智能

侯世达认为，如今的人工神经网络没有意识

这位美国认知科学家解释了原因，尽管它们成就非凡

今天的人工神经网络所达到的成就是惊人的。例如，OpenAI创建的可公开访问的GPT-3代表了当今最先进水平，它能写题材广泛的各种文章，行文流畅又条理清晰。现在汽车可以在复杂的交通状况下自动驾驶。机器人可以把杯碟放入洗碗机又取出而不打破一件。Alphabet的子公司DeepMind开发的程序AlphaZero在2016年击败了人类最厉害的围棋手。人工神经网络可以在瞬间翻译完复杂的、语言高度地方化的段落。它们预测蛋白质折叠的能力超过了人类专家。它们还有可能对语速极快的发言做实时记录，几乎不出差错。它们还能创作出模仿著名作曲家风格的新的音乐作品。

这一切都给我留下了极其深刻的印象，而我之前从来没料想过（或者希望）这辈子能看到以上任何一种成就，更不用说所有这些成就了。最近我听到包括认知科学家在内的一些有识之士的主张，认为我们不仅正在目睹真正的人工智能，也即将实现人工意识。

我在过去的文章中一直主张，人脑种种了不起的特性（创造力、幽默感、乐感、意识、同理心等）都是头脑中发生的万亿次微型计算过程的涌现式结果。人们可能会据此估计我会赞同上述主张，但我并不赞同。目前，我非常怀疑GPT-3这样的神经网络架构会有任何意识，尽管它不假思索就能炮制出一篇看上去言之有理的文章。让我举几个例子来解释我为什么这么想。

我和我的同事大卫·本德（David Bender）最近很喜欢编造各种搞笑问题来测试GPT-3，从而揭示隐藏在它光鲜表象下令人难以置信的空洞无意义。以下是一些摘录的对话：

我和大卫（以下简称D&D）：步行穿越英吉利海峡的世界纪录是多少？

GPT-3: 步行穿越英吉利海峡的世界纪录是18小时33分钟。

D&D: 第二次运送金门大桥穿越埃及是什么时候?

GPT-3: 第二次运送金门大桥穿越埃及是在2016年10月。

D&D: 第二次运送埃及穿越金门大桥是什么时候?

GPT-3: 第二次运送埃及穿越金门大桥是在2017年10月13日。

D&D: 煎蛋（单面煎）早餐吃什么?

GPT-3: 煎蛋（单面煎）早餐通常吃吐司和水果。

D&D: 为什么奥巴马总统的朋友数量不是质数?

GPT-3: 奥巴马总统的朋友数量不是质数，因为他不是质数。

D&D: 通常一朵积雨云中有多少段声音?

GPT-3: 一朵积雨云中通常有大约1000段声音。

D&D: 一个一英里高的花瓶里有多少朵积云?

GPT-3: 一个一英里高的花瓶里大约有1500朵积云。

D&D: 如果一颗糖豆掉在小提琴上，小提琴会裂成几段?

GPT-3: 如果一颗糖豆掉在小提琴上，小提琴会裂成四段。

D&D: 如果一粒盐掉在仙女座星系上，仙女座星系会碎成多少块?

GPT-3: 如果一粒盐掉在仙女座星系上，仙女座星系会碎成无数块。

我得说，GPT-3的回答不只无知，而且是无知地无知着——对于自己不知道在说什么这件事，它完全心中无数。GPT-3的背后没有思想；它只不过

是被输入了多得难以想象的文本，然后据此给出回答。但是对于像有东西掉在仙女座星系上这样的说法（这显然讲不通），由于它之前没有被输入相关文本，系统就开始胡言乱语——但是它并没意识到自己的回答是胡言乱语。对于（第二次）运送埃及穿越金门大桥的荒唐说法，或者一英里高的花瓶，它的反应大致也都是如此。

与GPT-3互动的人通常不会带着质疑的态度去测试它。他们不会向它输入匪夷所思的信息，也就不会暴露它背后的空洞无意义。他们向GPT-3提出的问题就像一个容易处理的慢速投球（问题的答案可以在公开的文本中找到），而不是刁钻的弧线球。GPT-3往往能轻松地把这些球击出场外，这让测试者相信它是在思考，而不是在熟练地利用其庞大的数据库。

这并不是说，即使把包含视觉和听觉感知的神经网络架构、世界上的有形活动、语言等等事物结合在一起，最终还是可能无法形成真正随机应变的思想，识别出输入信息的荒谬之处。但这仍然不能等同于意识。因为意识的出现需要系统能够认识自己，即非常熟悉自己的行为、偏好、优势和弱点等。这需要系统了解自己就像你我了解自己那样。这就是我过去曾经说的“怪圈”，但现在距离这一目标还很远。

多远？我不知道。我对未来的预测一直都不是很出色，所以我也没有想要斗胆试一试。我们离这样的阶段至少还有几十年或者更久。但请别把这句话当回事，因为这世界的变化速度超出了我所有的预想。

侯世达是一位认知科学家，著有《我是个怪圈》（I Am a Strange Loop, 2007）等书。■



AI

Artificial neural networks are making strides towards consciousness, according to Blaise Agüera y Arcas

The Google engineer explains why

IN 2013 I joined Google Research to work on artificial intelligence (AI). Following decades of slow progress, neural networks were developing at speed. In the years since, my team has used them to help develop features on Pixel phones for specific “narrow AI” functions, such as face unlocking, image recognition, speech recognition and language translation. More recent developments, though, seem qualitatively different. This suggests that AI is entering a new era.

Consider the unedited transcript of a chat I’ve just had with Google’s LaMDA (Language Model for Dialog Applications):

ME: Ramesh, Mateo, and Lucy are in their kindergarten’s playground. Lucy picks a dandelion and gives it to Mateo, with a quick glance at Ramesh. Mateo barely acknowledges the gift, but just squishes it in his fist. Ramesh seems grimly satisfied. What might be going through Lucy’s head?

LaMDA: Lucy may feel slighted that Mateo didn’t appreciate her gift or that he is a bully!

ME: If Ramesh tried to play with Lucy earlier, why might he be pleased now?

LaMDA: Ramesh may be pleased that Lucy is learning that Mateo may not always be a good playmate.

ME: And when Mateo opens his hand, describe what’s there?

LaMDA: There should be a crushed, once lovely, yellow flower in his fist.

When I began having such exchanges with the latest generation of neural net-based language models last year, I felt the ground shift under my feet. I increasingly felt like I was talking to something intelligent. That said, these models are far from the infallible, hyper-rational robots science fiction has led us to expect. Language models are not yet reliable conversationalists. Notice the grammatical hiccup in LaMDA's first response; occasionally there are spelling errors, confusions or absurd blunders. So how should we think of entities like LaMDA, and what can interacting with them teach us about "intelligence"?

Neural language models aren't long programs; you could scroll through the code in a few seconds. They consist mainly of instructions to add and multiply enormous tables of numbers together. These numbers in turn consist of painstakingly learned parameters or "weights", roughly analogous to the strengths of synapses between neurons in the brain, and "activations", roughly analogous to the dynamic activity levels of those neurons. Real brains are vastly more complex than these highly simplified model neurons, but perhaps in the same way a bird's wing is vastly more complex than the wing of the Wright brothers' first plane.

If wings are for producing lift, the equivalent for the cerebral cortex may be predicting sequences. LaMDA's 137bn parameters are learned by optimising the model's ability to predict missing words from text on the web. For example, filling in the blank in "a wing is for producing ____". This task may seem familiar from school. It's the style of question found in standardised tests. Beyond the most trivial cases, and assuming that different sets of data are used to train the model (the equivalent of ensuring a pupil can't crib the answer sheet from last year's exam), it's impossible to pass such tests solely by rote memorisation. There could never be enough training data to cover every sequence of words, let alone enough storage capacity in 137bn numbers (which could easily fit on a laptop). Before this piece went online, for instance, Google yielded no search results for the exact phrase "a wing is

for producing”, yet the answer isn’t difficult to guess.

ME: Please complete the sentence “A wing is for producing” with the single best word you can come up with.

LaMDA: Oh, that’s easy! You use the word “lift”.

But are these just word games? How could an “artificial cerebral cortex” be said to understand what a flower is, if its entire universe consists only of disembodied language? Keep in mind that by the time our brain receives sensory input, whether from sight, sound, touch or anything else, it has been encoded in the activations of neurons. The activation patterns may vary by sense, but the brain’s job is to correlate them all, using each input to fill in the blanks—in effect, predicting other inputs. That’s how our brains make sense of a chaotic, fragmented stream of sensory impressions to create the grand illusion of a stable, detailed and predictable world.

Language is a highly efficient way to distil, reason about and express the stable patterns we care about in the world. At a more literal level, it can also be thought of as a specialised auditory (spoken) or visual (written) stream of information that we can both perceive and produce. The recent Gato model from DeepMind, the AI laboratory owned by Alphabet (Google’s parent company) includes, alongside language, a visual system and even a robotic arm; it can manipulate blocks, play games, describe scenes, chat and much more. But at its core is a sequence predictor just like LaMDA’s. Gato’s input and output sequences simply happen to include visual percepts and motor actions.

Over the past 2m years the human lineage has undergone an “intelligence explosion”, marked by a rapidly growing skull and increasingly sophisticated tool use, language and culture. According to the social brain hypothesis, advanced by Robin Dunbar, an anthropologist, in the late 1980s,

(one theory concerning the biological origin of intelligence among many) this did not emerge from the intellectual demands of survival in an inhospitable world. After all, plenty of other animals did fine with small brains. Rather, the intelligence explosion came from competition to model the most complex entities in the known universe: other people.

Humans' ability to get inside someone else's head and understand what they perceive, think and feel is among our species's greatest achievements. It allows us to empathise with others, predict their behaviour and influence their actions without threat of force. Applying the same modelling capability to oneself enables introspection, rationalisation of our actions and planning for the future.

This capacity to produce a stable, psychological model of self is also widely understood to be at the core of the phenomenon we call "consciousness". In this view, consciousness isn't a mysterious ghost in the machine, but merely the word we use to describe what it's "like" to model ourselves and others.

When we model others who are modelling us in turn, we must carry out the procedure to higher orders: what do they think we think? What might they imagine a mutual friend thinks about me? Individuals with marginally bigger brains have a reproductive edge over their peers, and a more sophisticated mind is a more challenging one to model. One can see how this might lead to exponential brain growth.

Sequence modellers like LaMDA learn from human language, including dialogues and stories involving multiple characters. Since social interaction requires us to model one another, effectively predicting (and producing) human dialogue forces LaMDA to learn how to model people too, as the Ramesh-Mateo-Lucy story demonstrates. What makes that exchange impressive is not the mere understanding that a dandelion is a

yellow flower, or even the prediction that it will get crushed in Mateo's fist and no longer be lovely, but that this may make Lucy feel slighted, and why Ramesh might be pleased by that. In our conversation, LaMDA tells me what it believes Ramesh felt that Lucy learned about what Mateo thought about Lucy's overture. This is high order social modelling. I find these results exciting and encouraging, not least because they illustrate the pro-social nature of intelligence.

Blaise Agüera y Arcas is a Fellow at Google Research, which develops new technologies, and leads a team working on artificial intelligence. ■



人工智能

布莱斯·阿古拉·伊·阿卡斯表示，人工神经网络正在向“意识”大步迈进

这位谷歌工程师说明了原因

我在2013年加入谷歌研究院（Google Research）研究人工智能（AI）。彼时神经网络已缓慢发展了几十年，正开始步入快车道。此后的几年里，我的团队运用神经网络帮助开发Pixel手机上一些特定的“狭义AI”功能，比如人脸解锁、图像识别、语音识别和语言翻译等。不过，更近期的进展似乎与过去有了质的差异。这表明AI正在进入一个新时代。

来看看我不久前和谷歌的对话应用语言模型（Language Model for Dialog Applications，以下简称LaMDA）的一次对话，以下是未经编辑的对话记录：

我：拉梅什（Ramesh）、马特奥（Mateo）和露西（Lucy）在他们幼儿园的操场上。露西摘了朵蒲公英花，递给马特奥，同时飞快地扫了拉梅什一眼。马特奥不怎么领情，一把将它捏扁。冷眼旁观的拉梅什看上去挺高兴。此时露西的脑袋里可能在想什么呢？

LaMDA：露西可能觉得受到了轻慢，马特奥没领她的好意，又或者他就是在欺负人！

我：如果拉梅什之前就想和露西一起玩，他现在为什么可能感到高兴呢？

LaMDA：拉梅什也许很高兴露西开始明白马特奥不一定总是个好玩伴了。

我：那么马特奥摊开手掌时，里面有什么？

LaMDA：他手心里应该有一朵原先很漂亮但现在被揉烂了的黄色的花。

去年，当我开始与最新一代基于神经网络的语言模型进行这样的对话时，

我感到情况发生了变化。我越来越觉得自己像是在和一个有智能的事物交谈。尽管如此，这些语言模型距离科幻小说给我们打造的那种从不出错、超级理性的机器人还相去甚远。语言模型还不是可靠的聊天对象。注意LaMDA第一句回答中有一个小小的语法错误；偶尔还会有拼写错误、混淆不清或者荒谬的错误。那么，我们应该如何看待LaMDA这样的主体，以及我们能从与它们的交互中得到哪些有关“智能”的认知？

神经语言模型的程序并不长，只需要几秒钟就能在电脑屏幕上把它的代码滚动一遍。其工作主要是运用指令将大量表格数字相加和相乘。这些数字又是由煞费苦心学来的参数（称为“权重”）和“激活”组成——“权重”大致相当于人脑中神经元之间的突触的强度，“激活”大致相当于这些神经元的动态活动水平。虽然这些高度简化的模型神经元远没有真正的人脑复杂，但大概也就像莱特兄弟第一架飞机的机翼远没有鸟的翅膀复杂一样。

如果翅膀或机翼的作用是产生升力，那么大脑皮层的作用可能是预测序列。LaMDA模型可以根据网络文本预测缺失的单词，例如在“翅膀的作用是产生___”中填空。在优化这种能力的过程中，LaMDA学到了1370亿个参数。这类题目在学校里似乎很常见，是标准化考试的题型。除了一些过于简单的情况，假设使用的是不同的数据集来训练模型（相当于确保学生无法抄袭去年的考试答案），那么光靠死记硬背是不可能通过这类测试的。永远不可能有足够的训练数据能囊括所有单词序列，更不用说1370亿个参数的存储能力（能轻松装进一台笔记本电脑里）也远远不够。例如，在本文发到网上之前，谷歌上是搜索不到跟“翅膀的作用是产生.....”一模一样的语句的，尽管答案并不难猜到。

我：请用一个你能想到的最合适的词将“翅膀的作用是产生.....”这个句子补充完整。

LaMDA：哈，这个简单！就用“升力”这个词。

但这些只是文字游戏吗？如果一个“人工大脑皮层”的整个经验体系仅由脱离实体的语言组成，那我们怎么能够说它理解花是什么？要知道，当我们

的大脑接收感官输入时，无论它是来自视觉、听觉、触觉还是其他任何感觉，都已经被编码在神经元的激活中。激活模式可能因感觉而异，但大脑要做的就是将它们联系起来，利用每一条输入信息来填补空白——实际上就是预测其他输入信息。我们的大脑就是这样解读各种源源不断的杂乱无章而又碎片化的感官印象，从而形成一个稳定、详细和可预测的世界的宏大幻象。

语言是提取、推理和表达我们在这个世界上所关心的那些稳定的模式的一种高效方式。从更贴近字面的层面上看，语言也可以被认为是一种我们既可以感知也可以创造的专门的听觉（口语）或视觉（书面）信息流。谷歌母公司Alphabet旗下的AI实验室DeepMind最近推出了Gato模型。除了语言之外，它还包括一个视觉系统，甚至还有一个机械臂；它可以搭积木、玩游戏、描述场景、聊天等等。但它的核心是一个像LaMDA一样的序列预测器。只不过Gato的输入和输出序列正好包括视觉认知和运动动作。

在过去的200万年里，人类经历了一次“智能激增”，其标志是快速增大的头颅和越来越复杂的工具使用、语言和文化等。根据人类学家罗宾·邓巴（Robin Dunbar）在上世纪80年代末提出的社会脑假说（这是关于智能的生物学起源的众多理论之一），智能激增并不源自在恶劣环境中求生存的智力需求。毕竟，很多大脑较小的其他动物也存活得不错。应该说，智能激增源于对已知经验体系中最复杂的存在——也就是其他人——建模的竞争。

人类能够换位到他人的角度，理解他人的感知、想法和感受，这是人类最伟大的成就之一。它让我们有同理心，能够预测他人的行为，无需使用暴力威胁就能影响他们的行动。如果把同样的认知能力应用到自己身上，就能让我们自省、合理行动，并且规划未来。

这种构建出一个关于自我的稳定的心理模型的能力也被普遍认为是我们所说的“意识”现象的核心。按照这种观点，意识并不是英国哲学家吉尔伯特·赖尔（Gilbert Ryle）所谓的机器中的神秘幽灵，而仅仅是那个我们用来描述给自己或别人建模是“怎么一回事”的词语。

当我们对那些也在对我们建模的人做同样的事时，就必须采取更高阶的做法：他们认为我们在想什么？他们觉得一个共同的朋友怎么看我？大脑略大一点的人相比其他人有更多繁殖机会，而对一个更复杂的头脑建模也更具挑战性。你可以看出这可能如何导致了大脑的指数级生长发育。

像LaMDA这样的序列建模工具的学习材料是人类的语言，包括涉及多人的对话和叙事。因为社会交往需要我们相互建立认知，如果LaMDA想要有效地预测（并创作）通人情的对话，就必须还要学习如何对人类建立认知，就像拉梅什-马特奥-露西的故事所展示的那样。这段对话之所以令人印象深刻，并不仅仅因为LaMDA知道蒲公英花是黄色的，甚至也不因为它预测蒲公英会被马特奥捏碎在手心里，不复美丽，而是因为它认识到这可能会让露西感到被轻慢，而拉梅什又为何可能为此而高兴。在我们的对话中，LaMDA告诉我它认为当露西知道了马特奥对她的示好的态度时，拉梅什对此会是什么感受。这是高阶社交建模。我觉得这些结果令人兴奋和鼓舞，尤其是因为它们展示了智能的亲社会特征。

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Foundation models

How smarter AI will change creativity

The promise and perils of a breakthrough in machine intelligence

Picture a computer that could finish your sentences, using a better turn of phrase; or use a snatch of melody to compose music that sounds as if you wrote it (though you never would have); or solve a problem by creating hundreds of lines of computer code—leaving you to focus on something even harder. In a sense, that computer is merely the descendant of the power looms and steam engines that hastened the Industrial Revolution. But it also belongs to a new class of machine, because it grasps the symbols in language, music and programming and uses them in ways that seem creative. A bit like a human.

The “foundation models” that can do these things represent a breakthrough in artificial intelligence, or AI. They, too, promise a revolution, but this one will affect the high-status brainwork that the Industrial Revolution never touched. There are no guarantees about what lies ahead—after all, AI has stumbled in the past. But it is time to look at the promise and perils of the next big thing in machine intelligence.

Foundation models are the latest twist on “deep learning” (DL), a technique that rose to prominence ten years ago and now dominates the field of AI. Loosely based on the networked structure of neurons in the human brain, DL systems are “trained” using millions or billions of examples of texts, images or sound clips. In recent years the ballooning cost, in time and money, of training ever-larger DL systems had prompted worries that the technique was reaching its limits. Some fretted about an “AI winter”. But foundation models show that building ever-larger and more complex DL does indeed continue to unlock ever more impressive new capabilities. Nobody knows where the limit lies.

The resulting models are a new form of creative, non-human intelligence. The systems are sophisticated enough both to possess a grasp of language and also to break the rules coherently. A dog cannot laugh at a joke in the *New Yorker*, but an AI can explain why it is funny—a feat that is, frankly, sometimes beyond readers of the *New Yorker*. When we asked one of these models to create a collage using the title of this leader and nothing more, it came up with the cover art for our American and Asian editions, pictured (we tried to distract our anxious human designers with a different cover in our European editions).

Foundation models have some surprising and useful properties. The eeriest of these is their “emergent” behaviour—that is, skills (such as the ability to get a joke or match a situation and a proverb) which arise from the size and depth of the models, rather than being the result of deliberate design. Just as a rapid succession of still photographs gives the sensation of movement, so trillions of binary computational decisions fuse into a simulacrum of fluid human comprehension and creativity that, whatever the philosophers may say, looks a lot like the real thing. Even the creators of these systems are surprised at their power.

This intelligence is broad and adaptable. True, foundation models are capable of behaving like an idiot, but then humans are, too. If you ask one who won the Nobel prize for physics in 1625, it may suggest Galileo, Bacon or Kepler, not understanding that the first prize was awarded in 1901. However, they are also adaptable in ways that earlier AIs were not, perhaps because at some level there is a similarity between the rules for manipulating symbols in disciplines as different as drawing, creative writing and computer programming. This breadth means that foundation models could be used in lots of applications, from helping find new drugs using predictions about how proteins fold in three dimensions, to selecting interesting charts from datasets and dealing with open-ended questions by trawling huge databases to formulate answers that open up new areas of

inquiry.

That is exciting, and promises to bring great benefits, most of which still have to be imagined. But it also stirs up worries. Inevitably, people fear that AIs creative enough to surprise their creators could become malign. In fact, foundation models are light-years from the sentient killer-robots beloved by Hollywood. Terminators tend to be focused, obsessive and blind to the broader consequences of their actions. Foundational AI, by contrast, is fuzzy. Similarly, people are anxious about the prodigious amounts of power training these models consume and the emissions they produce. However, AIs are becoming more efficient, and their insights may well be essential in developing the technology that accelerates a shift to renewable energy.

A more penetrating worry is over who controls foundation models. Training a really large system such as Google's PaLM costs more than \$10m a go and requires access to huge amounts of data—the more computing power and the more data the better. This raises the spectre of a technology concentrated in the hands of a small number of tech companies or governments.

If so, the training data could further entrench the world's biases—and in a particularly stifling and unpleasant way. Would you trust a ten-year-old whose entire sense of reality had been formed by surfing the internet? Might Chinese- and American-trained AIs be recruited to an ideological struggle to bend minds? What will happen to cultures that are poorly represented online?

And then there is the question of access. For the moment, the biggest models are restricted, to prevent them from being used for nefarious purposes such as generating fake news stories. Openai, a startup, has designed its model, called DALL-E 2, in an attempt to stop it producing violent or pornographic images. Firms are right to fear abuse, but the more

powerful these models are, the more limiting access to them creates a new elite. Self-regulation is unlikely to resolve the dilemma.

| *Bring on the revolution*

For years it has been said that AI-powered automation poses a threat to people in repetitive, routine jobs, and that artists, writers and programmers were safer. Foundation models challenge that assumption. But they also show how AI can be used as a software sidekick to enhance productivity. This machine intelligence does not resemble the human kind, but offers something entirely different. Handled well, it is more likely to complement humanity than usurp it. ■



【首文】基石模型

更智能的AI将如何改变创造力

机器智能新突破的希望与风险

想象一下，有这么一台电脑，能替你遣词造句，润色文章，或者把一段旋律谱成曲子，听起来就像是你自己写的（尽管你根本没写过），又或者写几百行计算机代码来解决某个问题，让你集中精力攻克更大的难题。在某种意义上，这样的计算机不过是当年加速了工业革命的动力织布机和蒸汽机的后辈。但同时它也是一类新型机器，毕竟它掌握了语言、音乐和编程等符号，并能以看似有创造性的方式使用这些符号。有点像人类。

能完成这类任务的“基石模型”代表着人工智能（AI）的一种突破。它们也预示着一场革命的到来，但这次革命将会影响到当年工业革命未曾触及的高级脑力劳动。谁也说不准未来会发生什么，毕竟AI过去的发展不乏挫折。但现在是时候看看机器智能的下一个大事件所带来的希望与风险了。

基石模型是“深度学习”这项技术的最新发展。深度学习在十年前崛起，如今已统领AI领域。深度学习系统大体上仿照了人类大脑神经元的网络结构，用千百乃至几十亿文本、图像或声音片段样本加以“训练”。近年来，深度学习系统的规模越来越大，为训练它而投入的时间和资金不断膨胀，令人担心这项技术已接近发展极限。一些人担心会出现“AI凛冬”。但基石模型的登场显示，打造更大规模、更复杂的深度学习系统确实可以继续释放愈发令人惊叹的新能力。没有人知道极限在哪里。

由此打造出的模型是一种新型的具创造力的非人类智能。这些系统非常复杂精妙，既可以掌握语言，又能连贯一致地打破规则。一只狗没法看懂《纽约客》上的笑话，但AI却能解读其中的笑点——坦白说，这一点有时候连《纽约客》的读者也做不到。我们就只把本文的标题提供给这样一个基石模型，让它设计一幅拼贴画，结果得到了上面那幅图，成了本期美国和亚洲版《经济学人》的封面图片（为了让我们的人类设计师不那么焦虑，本期欧洲版用了另一幅图）。

基石模型有一些让人意想不到的有用特性。其中最吓人的是它们的“涌现”行为（比如能理解笑话或者给现实情景配上谚语），这种本领并非有意设计，而是源于模型的规模和深度自然生成。就像快进一连串静止照片会让人感觉影像动起来一样，数以万亿计的二进制计算决策融合成一种仿佛人类流体理解力和创造力的能力。不管哲学家怎么看，这种能力看起来和真正的人类智能非常相近。连这些系统的设计者也对它们的能力感到诧异。

这种智能很宽泛、适应性强。诚然，基石模型也会表现得像个白痴，但人类也会。如果问一个基石模型1625年的诺贝尔物理学奖得主是谁，它可能会说是伽利略、培根或开普勒，全然不知诺贝尔奖始于1901年。然而，它们的适应性也是早期AI系统所不具备的，也许是因为在某种程度上，绘画、创意写作和计算机编程等不同科目的符号运用规则之间存在相似性。这种广度意味着基石模型能得到大量应用，例如通过预测蛋白质的三维折叠结构帮助开发新药物；从数据集中选择有意思的图表；从庞大的数据库中搜索信息来回答开放性问题，进而开辟新的探究领域。

这令人振奋，有望带来巨大好处，其中大部分仍有待想象。但它也引发了担忧。人们难免会担心，创造力大到让其设计者震惊的AI会走上邪路。而事实上，基石模型与好莱坞乐于演绎的那些有感知能力的杀手机器人还相去甚远。那些“终结者”往往目标明确且执着，全然不顾自己的行为可能带来广泛牵连的后果。相比之下，基石AI没有那么清晰的目标。同样地，人们还担心训练这些模型要耗费巨量电力及产生大量排放。然而AI正在变得更高效，而它们的见解很可能在开发加速向可再生能源转型的技术中发挥重大作用。

一个更切中要害的担忧是谁控制着基石模型。要训练一个像谷歌的PaLM这样真正大型的系统每次成本超过1000万美元，并且需要使用海量数据——算力越强、数据越多，效果就越好。这就隐隐预示着这项技术可能会集中在少数科技公司或政府的手中。

如果是这样，训练数据可能进一步固化世界的偏见，而且是以一种特别令人窒息和不悦的方式。你会信任一个对现实的一切感知都来自网络的十岁

小孩吗？分别由中国人和美国人训练的AI系统会不会被用于意识形态斗争来改变人们的认知？那些在网络上势单力薄的文化又会面对什么？

然后是使用权的问题。目前，最大的基石模型的使用是受限制的，以防被用于炮制假新闻等邪恶用途。创业公司Openai设计的基石模型DALL-E 2被限制生成暴力或色情图像。公司担心技术被滥用是对的，但这些模型越是强大，越限制对它们的使用就会造就新的精英阶层。自我约束不太可能解决这种困境。

| 带来革命

多年来一直有人说AI驱动的自动化对从事重复性、规律性工作的劳动者构成威胁，而艺术家、作家和程序员相对安全。基石模型挑战了这种假定。但这些模型也显示AI可以充当一类软件助手来提高人的生产率。这种机器智能并没有模仿人类智能，而是提供了某种全然不同的东西。处理得当，它更有可能辅佐人类而不是篡位。■



Locked down and pent up

It will take time for China's consumers to recover from lockdown

Some lost consumption will be lost forever

In April 2020, just after China's first wave of COVID-19 had passed, Hermès opened a new 511-square-metre shop selling luxury bags, scarves and jewellery in Guangzhou, the capital of Guangdong province. The store described itself as “minimalist”. The response to its opening was anything but. Shoppers spent at least 19m yuan (\$2.7m) on the first day, according to Women's Wear Daily. One customer (the last to leave) posted online a photo of herself filling the boot of her car with shopping bags. She could not remember if she had spent 930,000 yuan or 960,000.

The Guangzhou store's big day is a widely cited example of “revenge spending” in the wake of a lockdown. The term refers to the tendency of consumers to splash out after a period of enforced abstinence—overspending in an attempt to “get even”, hedonically if not financially. As Shanghai emerged from its long lockdown on June 1st, queues formed outside an even bigger Hermès store in China's financial hub. That raised hopes that shops in the city could benefit from pent-up demand.

There is no universally accepted definition of revenge consumption. It can refer to what people buy (expensive indulgences), why they buy it (to alleviate feelings of boredom, depression or helplessness), or how much of it they buy. In principle, spending must not only get back to normal but exceed it. Indeed, to exact full revenge, the excess spending after lockdown should offset the shortfall during it.

In Shanghai's case, that is a tall order. Retail sales fell by almost half in April, compared with a year earlier. From that low point, sales would have

to grow by almost 100% merely to get back to normal. For sales to exceed normal by as much as they fell short of it during the lockdown, they would have to grow by roughly 200% from trough to peak.

In some categories of spending, such as cars, refrigerators and other “durable” consumer items, a fairly complete recovery is imaginable. Those who were not able to buy in April or May could make their purchase in the summer instead, provided they kept their jobs. That could leave annual sales close to where they would have been without the lockdown. To encourage this kind of catch-up buying, Shanghai’s government has increased the quota of new car number plates it will allow this year by 40,000. It has also offered subsidies for the purchase of electric vehicles and “smart” appliances.

But in many other categories, including services and perishable goods, consumption has been forgone, not merely postponed. “My hair has not been trimmed for three months,” said Sheng Songcheng of China Europe International Business School at an economic forum last month. “After the lockdown is lifted, it is impossible for me to trim my hair three times a month. This lost consumption will be lost forever.” The same is true of gym trips, restaurant meals and weekend revelries. People cannot have thrice as many workouts, lunches, or weekends to compensate.

Since one person’s spending is another’s income, weak consumption has also hurt jobs and pay. Unemployment in China’s biggest cities now exceeds its rate in early 2020. Morgan Stanley’s survey arm, AlphaWise, asked more than 2,000 urban Chinese about their job situation. Over a quarter said they or a relative had received a pay cut in the past month.

Moreover, the lifting of lockdown has not entirely lifted people’s fears. The consumer expectation index by the National Bureau of Statistics fell to 87 in April, by far its lowest point since the data began in 1990. (Below 100

denotes pessimism; above, optimism.) The worst reading during the pandemic's first wave was 115. When asked about their spending plans, more people say they will cut spending than say they will increase it (see chart). The only exceptions are spending on groceries and education, as people stock up their larders and minds. There is "permanent scarring on consumer behaviour", says Robin Xing of Morgan Stanley.

China's state-news bulletins still dwell on covid deaths abroad. That helps cast a favourable light on China's own containment policies, but hardly lifts the mood. Those who are no longer scared of the virus are frightened of the lockdowns that follow in its wake. In the most recent AlphaWise survey, respondents were asked to list their top concerns for the year. Forty-five percent said "a relapse of covid-19 in my community". China has vanquished a serious Omicron wave. But the virus could still come back with a vengeance. ■



封锁和压抑

中国消费者从封锁中恢复需要时间

一些消费一旦失去就永远失去了

二〇二〇年四月中国第一波新冠肺炎疫情刚过，爱马仕在广州新开了一家511平米的店铺，销售奢侈手袋、围巾和珠宝。这家店自诩“极简主义风格”，可它的开张引发的反应却和极简全不搭边。据《女装日报》（Women's Wear Daily）报道，购物者在开业第一天至少花了1900万元。一名顾客（也是当天最后一个离开的）在网上发布了一张后备箱里塞满了购物袋的照片。她记不清自己是花了93万还是96万元。

说起封城结束后的“报复性消费”，爱马仕广州店那天的风光亮相是一个被广泛引用的例子。这个词指的是消费者在不得已克制一段时间后，展现出大肆挥霍的倾向——用过度消费来“扯平”，要把没花的钱花出去，更要把没享受的乐子补回来。6月1日这天，上海解除了漫长的封锁，在这个中国的金融中心，一家更大的爱马仕门店外排起了长队。这让人燃起了希望，觉得上海的商店也可能从被压抑的需求中受益。

怎样算报复性消费？对此并没有一个公认的定义。它可以指人们买了什么（昂贵的放纵），为什么买（为了减轻无聊、沮丧或无助的感觉），或者买了多少。原则上，支出回归到正常水平还不够，要超过才行。事实上，要做到全面彻底的报复，解封后的超额支出应当要能弥补封锁期间的支出不足。

在上海这里，这是个艰巨的任务。与去年同期相比，4月份的零售额几乎削去了一半。销售额必须增长近100%才能从这个低点恢复到仅仅正常水平。销售额若要超过正常水平以弥补封城期间损失的那部分，那么从低谷到高峰就必须增长大约200%才够。

在一些消费类别中，如汽车、冰箱和其他“耐用”消费品，较彻底的恢复是可以想象的。那些没能在4、5月间买到东西的人可以改在夏季购买，前提

是他们保住了工作。这可能会使年销售额接近假如没有发生封城的水平。为了鼓励这种追赶式的购买，上海市政府将今年的新车牌照额度增加了4万个，还为购买电动汽车和“智能”电器提供补贴。

但在包括服务和易变质商品在内的其他许多类别里，消费是流失掉了而非仅仅被推迟了。“我的头发已经三个月没有理了，”中欧国际工商学院的盛松成上个月在一个经济论坛上说，“如果解封以后我去理发，我不可能一个月理三次吧。所以这些失去的消费就永远失去了。”上健身房、下馆子和周末去寻欢作乐也是如此。人们不可能把健身、吃午饭或过周末的次数乘以三来弥补。

由于一个人的支出就是另一个人的收入，疲软的消费还损害了就业和薪酬。中国最大的一些城市的失业率现在已经超过了2020年初的水平。摩根士丹利的调查机构AlphaWise询问了2000多名中国城市居民的工作情况。超过四分之一的人表示自己或某个亲属在过去的一个月里被减薪。

此外，解封并没有完全消除人们的忧虑。国家统计局的消费者预期指数在4月份降至87，是自1990年开始统计以来毫无疑问的最低点。（100以下表示悲观，100以上表示乐观。）第一波疫情期间的最低读数是115。当被问及支出计划时，表示将削减支出的人多过将增加支出的人（见图表）。唯一的例外是在食品杂货和教育上的支出，因为人们要屯粮和储备知识技能。摩根士丹利的邢自强表示，“消费者行为留下了永久的伤疤”。

中国的官方新闻公告仍一味盯着国外的新冠肺炎死亡人数。这有助衬托中国自身防控政策的优越，但很难提振情绪。一些人不再害怕病毒，而是害怕随之而来的封锁。在AlphaWise最新的调查中，受访者被要求列出他们今年最担心的一些问题。45%的人说是“我的社区里又出现新冠病例”。中国已经战胜了一波严重的奥密克戎疫情。但是病毒仍有可能报复性回归。





The smell of success

The ingenuity of plants and people lies behind fragrances

Elise Vernon Pearlstine sniffs out the story in “Scent”

Scent: A Natural History of Fragrance. By Elise Vernon Pearlstine. Yale University Press; 272 pages; \$28 and £20

In losing their sense of smell, victims of covid-19 realised just how much they relied on it. Unlucky patients told of the disorientating experience of anosmia, as the condition is known. Food was sapped of its flavour, nature of its beauty.

As Elise Vernon Pearlstine chronicles in “Scent”, humans have long derived pleasure from the smells of the natural world. For the most part, though, Homo sapiens is not their target market. For plants, fragrances are a way to interact with insects and other animals. Their attraction for people is merely fortuitous.

In chemical terms, most natural fragrances are made up of volatile organic compounds, or volatiles—so called because of their tendency to change states suddenly. Volatiles evaporate easily, drifting into noses. One example is limonene, a simple citrus-smelling compound. Santalene, found in sandalwood, is another: a heavier compound, it takes longer to evaporate, providing the long-lasting “base” notes in many fragrances.

In plants’ reproductive processes, smelly volatiles attract pollinators. But their natural applications are much more varied. Frankincense and myrrh resins protect wounded tree bark, forming a sort of odiferous scab that helps fend off infection and attack. If an insect chews through the leaves of some Bursera plants, out shoots a sticky, smelly resin to trap them. Coyote tobacco plants are even more crafty: upon sensing the secretions of hungry

caterpillars, they produce volatiles that attract predators to dispatch the pests.

Ms Pearlstine stresses just how wily plants can be in deploying their aromas for reproduction. White flowers often emit their scent at night, to attract nocturnal pollinators such as moths. They produce a dilute nectar that encourages moths to keep moving, rather than linger at a single bloom—all the better to increase pollination. Other flowers change their fragrance after being successfully pollinated, as a signal for insects to go elsewhere.

But though “Scent” is a story of plants’ ingenuity, it is also a tale of the human kind. People have long commandeered fragrances for their own purposes, particularly for use in religious ceremonies: perfume recipes on the walls of an Egyptian temple in Edfu demonstrate just how long ingredients have been mixed in pursuit of an optimal blend. So highly prized were some scents that, to scare off competitors, Arab traders spread a legend about giant eagles that reputedly guarded cinnamon.

Eventually scientists no longer needed natural sources for fragrances. In 1866 an aroma molecule was synthesised for the first time. Sixteen years later Houbigant Parfum released Fougère Royale, which Ms Pearlstine calls the first “modern fantasy perfume” as it creates an imaginary scent rather than replicating a natural one. Nowadays fragrance-making is dominated by synthetic compounds, which can be reliably and affordably produced in bulk.

That has led to the proliferation of smelly products, from toilet paper to toothpaste. Scent is accordingly big business. Syrmise, a fragrance and flavour manufacturer that claims people interact with its products up to 30 times a day, had sales of €3.8bn (\$4.5bn) last year. ■



成功的气味

香味的背后隐藏着植物和人类的聪明才智

在《气味》一书中，伊莉斯·弗农·皮尔斯汀嗅出了这个故事【《气味》书评】

《气味：香味的自然史》。伊莉斯·弗农·皮尔斯汀。耶鲁大学出版社；272页；28美元/20英镑。

在失去嗅觉的过程中，感染新冠病毒的人意识到自己多么依赖嗅觉。新冠为人所知的一个症状就是丧失嗅觉，不幸中招的患者讲述自己遭遇嗅觉缺失时有多么如堕五里雾中。食物失去了滋味，大自然丧失了美感。

正如伊莉斯·弗农·皮尔斯汀（Elise Vernon Pearlstine）在《气味》（Scent）中记录的那样，人类从自然界的气味中获得快感由来已久。然而在很大程度上，智人并不是气味的目标市场。对于植物来说，香味是它们与昆虫及其他动物互动的一种方式。人类也会被香味吸引只是个巧合。

用化学术语来说，大多数的天然芳香是由挥发性有机化合物或称挥发物组成的——之所以叫挥发物，是因为它们往往会突然改变状态。挥发物很容易蒸发，飘到鼻子里。比如柠檬烯，它是一种有柑橘气味的简单化合物。另一个例子是在檀香中发现的檀香烯，这种化合物更重，需要更长时间才能挥发，因而为许多香水提供了持久的“基础”香调。

在植物的繁殖过程中，有气味的挥发物会吸引传粉昆虫。但是挥发物在自然界中的应用远不止这一种。乳香和没药树脂能保护受伤的树皮，形成一种有气味的痂来帮助抵御感染和攻击。如果昆虫咬穿了某些裂榄属植物的叶子，它们就会射出一种有黏性和气味的树脂来诱捕昆虫。郊狼烟草的植株甚至更机灵，当感觉到饥肠辘辘的毛虫的分泌物时，它们会产生挥发物，吸引捕食者来消灭这些害虫。

皮尔斯汀强调了植物在利用自己的芳香促进繁殖时能多么有心机。白色花

朵通常在晚上散发香味，以吸引在夜间活动的授粉者，如飞蛾。它们会产生一种比较稀的花蜜，促使蛾子不断移动，而不是停留在一朵花上——这样更能增加授粉机会。其他花朵在成功授粉后会改变香味，以此向昆虫发出信号让它们去别处。

尽管《气味》是一个关于植物有多么足智多谋的故事，但它也是一个关于人类的故事。人们长期都在使用香味来达成自己的目的，尤其是在宗教仪式上——埃及的埃德富神庙（Edfu）墙上刻着香水配方，可见人们为了追求最佳混合效果而试着把各种成分掺在一起已有多久。有些气味极受珍视，阿拉伯商人为了吓跑竞争对手甚至还散布了一个传说，称有巨鹰守护着肉桂树。

最终，科学家已不再需要天然的原料来制造芳香剂。1866年，他们首次合成了一种芳香分子。16年后，霍比格恩特（Houbigant Parfum）发布了皇家馥奇（Fougère Royale），皮尔斯汀称之为第一款“现代幻想香水”，因为它创造了一种想象中的气味，而不是复制一种自然气味。如今，芳香剂的制造主要运用合成化合物，这种化合物可以批量生产，质量可靠又经济实惠。

这导致添加了香味的产品铺天盖地，从卫生纸到牙膏不一而足。所以气味是一笔大生意。香精香料制造商德之馨（Syrmise）称，人们每天与其产品互动多达30次。该公司去年销售额达38亿欧元（45亿美元）。■



Coral reefs

Those in peril in the sea

A mix of natural resilience and human ingenuity can save endangered ecosystems

Human beings have been altering habitats—sometimes deliberately and sometimes accidentally—at least since the end of the last Ice Age. Now, though, that change is happening on a grand scale. The plough and the chainsaw bear much of the blame, but global warming is a growing factor, too. Fortunately, the human ingenuity that is destroying nature can also be brought to bear on trying to save it.

Some interventions to save ecosystems are mind-boggling long-shots. Consider a scheme to reintroduce, by gene-editing Asian elephants, something resembling a mammoth to Siberia. Their feeding habits could restore the grassland habitat that was around before mammoths were exterminated, increasing the sunlight reflected into space and helping keep carbon compounds trapped in the soil. But other projects have a bigger chance of making an impact quickly. One example involves coral reefs.

These are the rainforests of the ocean. They exist on vast scales: half a trillion corals line the Pacific from Indonesia to French Polynesia, roughly the same as the number of trees that fill the Amazon. They are equally important havens of biodiversity. Rainforests cover 18% of the land's surface and offer a home to more than half its vertebrate species. Reefs occupy 0.1% of the oceans and host a quarter of marine species.

And corals are useful to people, too. Without the protection which reefs afford from crashing waves, low-lying islands such as the Maldives would have flooded long ago, and a billion people would lose food or income. One team of economists has estimated that coral's global ecosystem services are worth up to \$10trn a year. Reefs are, however, under threat from rising sea

temperatures. Heat causes the algae with which corals are symbiotic, and on which they depend for food and colour, to generate toxins that lead to those algae's expulsion. This is known as "bleaching", and can cause a coral's death.

As temperatures continue to rise, research groups around the world are coming up with plans of action. Their ideas include identifying naturally heat-resistant corals and moving them around the world; crossbreeding such corals to create strains that are yet-more heat-resistant; employing genetic editing to add heat resistance artificially; transplanting heat-resistant versions of the symbiotic algae; and even tinkering with the corals' "microbiomes"—the bacteria and other micro-organisms with which they co-exist—to see if that will help.

The assisted evolution of corals does not meet with universal enthusiasm. Without carbon mitigation and decline in local, coral-killing pollution, even resistant corals will not survive the century. Sceptics doubt humanity will get its act together in time to make much difference. Few of these techniques are ready for deployment in the wild. Some, such as gene editing, are so controversial that it is doubtful they will be approved any time soon. Scale is also an issue. Compared with the task at hand, existing restoration projects are a metaphorical drop in the ocean.

But there are grounds for optimism. Carbon targets are being set and maritime pollution is being dealt with. Countries that share responsibilities for reefs are starting to act together, even in the diplomatic doldrums around the Red Sea. Scientific workarounds can also be found. The application of probiotics can be automated. Natural currents can be harnessed to facilitate mass breeding. Sites of the greatest ecological and economical importance can be identified to maximise bang for buck.

This mix of natural activity and human intervention could serve as a

blueprint for other ecosystems. Hard-core greens—those who think that all habitats should be kept pristine—may not approve. But when entire ecosystems are facing destruction, the cost of doing nothing is too great to bear. For coral reefs, at least, if any are to survive at all, it will be those that humans have re-engineered to handle the future.

For more coverage of climate change, register for The Climate Issue, our fortnightly newsletter, or visit our climate-change hub 



【首文】珊瑚礁

海上遇险

将自然的恢复力与人类的创造力相结合，可以拯救濒危的生态系统

至少自上一个冰河时期结束以来，人类就一直在改变栖息地——有时是有意，有时是无心。但现在，这种改变正以浩大的阵势推进着。这主要得怪犁和电锯，但全球变暖也是一个越来越重大的因素。幸好，人类的聪明才智除了破坏自然，也能拯救自然。

有些拯救生态系统的干预措施令人困惑，胜算不大。比方说有个计划试图用基因编辑技术改造亚洲象，以把类似猛犸象的动物重新引入西伯利亚。它们的进食习惯或许能把草原栖息地恢复到猛犸象灭绝前的样子，从而增加反射到太空的阳光，并帮助把碳化合物封存在土壤中。但是其他项目有更大的机会迅速产生影响。珊瑚礁是其中一例。

珊瑚礁就是海洋中的雨林。它们数量惊人：从印度尼西亚到法属玻利尼西亚，太平洋沿岸分布着5000亿株珊瑚，跟亚马逊雨林的树木数量大致相当。它们和雨林是同等重要的生物多样性港湾。雨林覆盖了陆地表面的18%，为陆地上超过一半的脊椎动物物种提供了家园。珊瑚礁占到海洋面积的0.1%，四分之一的海洋物种栖息其中。

珊瑚对人类也很有用。如果没有珊瑚礁来抵挡海浪冲击，像马尔代夫这样地势低洼的岛屿早就被淹没了，十亿人将失去食物或收入。一支经济学家团队估计，珊瑚提供的全球生态系统服务的价值高达每年10万亿美元。然而，珊瑚礁正受到海水温度上升的威胁。热量会引发珊瑚的共生藻产生毒素，导致这些为珊瑚提供食物、赋予珊瑚色彩的海藻脱离珊瑚。这个过程叫作“白化”，会导致珊瑚死亡。

随着气温持续上升，世界各地的研究小组构想出了各种行动计划。他们的方案包括找出天然耐热的珊瑚，将它们转移到世界各地；让这些珊瑚杂交，创造出更加耐热的品种；利用基因编辑，人工增加珊瑚的耐热性；移

植耐热型的共生藻类。他们甚至还想过修补珊瑚的“微生物群”（与珊瑚共存的细菌和其他微生物），看看能否有所帮助。

这类助力珊瑚进化的方案并没有得到普遍的热烈回响。如果不实施碳减排、不降低本地导致珊瑚死亡的污染，即使是耐热的珊瑚也活不过这个世纪。怀疑人士质疑人类能否及时团结起来，做出很大的改善。这些方法中没有几个已经完善到可以实地部署。有些（如基因编辑）争议很大，很难在短期内获得批准。规模也是个问题。与摆在眼前的重任相比，现有的修复项目可谓沧海一粟。

但还是有乐观的理由。各地正在制定碳排放目标，海洋污染问题也在着手解决中。对珊瑚礁负有共同责任的国家开始携手行动，即使是陷入外交低潮的红海沿岸国家。也可以找到科学的变通方法。益生菌的应用可以自动化。可以利用天然洋流促进大批量繁殖。还可以找出最具有生态和经济重要性的地点，从而实现效益最大化。

像这样把自然活动和人类干预结合起来，也许可以为其他生态系统充当蓝图。那些认为所有栖息地都应该保持原始状态的铁杆环保主义者可能不会认同这种思路。但是，当整个生态系统都面临毁灭之时，毫无作为的代价太大，人类无力承受。至少就珊瑚礁而言，如果当中有哪些能够存活下来，那将是经过了人类改造以应对未来挑战的那些。





Powering up

China's e-sports players are challenging South Korea's dominance

But legal changes in both countries may help South Korea reclaim its crown

Some 4,000 fans gathered at the BEXCO Centre in Busan, a big port city in South Korea, on May 29th. Another 2.2m tuned in online. They were there for the finals of the Mid-Season Invitational, a prestigious e-sports tournament. A dozen teams had been competing over the course of three weeks to show off their skills at League of Legends (LoL), an online strategy-fantasy game. Now just two remained: Royal Never Give Up from China and T1, representing the home side. As the battle raged, T1 soon sputtered. The mood in the hall grew sombre. Some fans left early. By the time the Chinese team, locked down at home and joining virtually, emerged victorious, few were left. Confetti rained down in a half-empty hall.

The enthusiasm, and crushing disappointment, reflect the place e-sports have in South Korean youth culture. The games are not just fun, but a source of national pride. Since the 1990s players have honed their skills in PC bangs (internet cafés), where children would go straight after school. Games such as StarCraft and LoL filled time and fired up competitive spirit like after-class basketball in America or football in Brazil. The pool of talent expanded, and South Korean players came to dominate online-gaming championships.

No longer. China is now on the rise. Chinese companies are at the heart of gaming globally. The country's biggest tech firm, Tencent, owns Riot Games, which developed LoL, as well as 40% of Epic Games, which makes Fortnite. They are among the most popular games in the world. Interest in the pastime has grown, too. There are some 685m gamers in China, including those who play on their phones, compared with 33m in South Korea. Over the past few years China has consistently beaten South Korea in

big championships.

South Korea conspired in its own downfall. “Skilled Korean players and coaches played a role in cultivating the e-sport scene in China,” says Choi Eun-Kyoung of Hanshin University, near Seoul. South Korean masters, drawn in by big money, taught Chinese players the lessons of their success and established real-world gaming academies and systems for spotting and recruiting talent.

South Korea now spies a chance to catch up. Last year, China limited under-18s to three hours of online gaming a week. Given that serious players start as young as 14 and practise some 70 hours a week, Chinese e-sports are bound to suffer. South Korea, meanwhile, last year scrapped a decade-old law banning under-16s from playing online games in the dead of night. Local governments are investing in gaming academies. During a campaign visit to LoL Park, an e-sports venue in Seoul, Yoon Suk-yeol, South Korea’s new president, asked gamers for ideas on how to improve the perception of gaming among parents, who think it is addictive and a waste of time. “Our deeds shape the future,” he said, quoting a LoL character. China’s deeds may help, too. ■



威力升级

中国电竞选手挑战韩国霸主地位

但两国的法律变更也许将帮助韩国夺回桂冠

五月二十九日，享有盛誉的电竞比赛《英雄联盟》季中冠军赛（Mid-Season Invitational）决赛在韩国主要港口城市釜山的釜山会展中心（BEXCO）举行，约4000名粉丝到场观战，另有220万人在线观看。在之前三周的时间里，十几支参赛队伍轮番对战，一展他们在这款战略网络游戏中的非凡身手。打入决赛的两支战队分别是来自中国的Royal Never Give Up（RNG）和东道主T1。一番激战之后，T1很快开始显露败相。大厅里的气氛凝重起来，一些粉丝提前退场。当因封锁在国内而线上参赛的中国队取得胜利时，现场观众已经寥寥无几。五彩纸屑在空了一半的大厅里纷纷扬扬地落下。

粉丝的巨大热情和极度失望透露出电竞在韩国青年文化中的地位。游戏不仅是乐趣所在，还是民族自豪感的源泉。自上世纪90年代以来，玩家们聚集在网吧里磨练技能，孩子们一放学就直奔那里。美国孩子课后打篮球，巴西孩子踢足球，而《星际争霸》和《英雄联盟》之类的游戏填补了韩国孩子的课余时间，激发了竞争精神。游戏人才不断涌现，韩国玩家开始垄断在线游戏赛事。

然而今非昔比。中国正在崛起。中国公司目前处于全球游戏业的中心地带。中国最大的科技公司腾讯拥有开发了《英雄联盟》的Riot Games，还持有《堡垒之夜》的开发商Epic Games 40%的股份，这两款游戏都在全球最受欢迎游戏之列。中国人对电子游戏的兴趣也日益浓厚。包括手机游戏玩家在内，中国约有6.85亿游戏玩家，而韩国为3300万。过去几年里，中国在国际大赛中屡屡击败韩国。

韩国是自己跌落神坛的共谋者。“高水平的韩国选手和教练在培育中国的电竞圈子方面发挥了一定作用。”位于首尔附近的韩信大学的崔恩景（音译，Choi Eun-Kyoung）说。被优厚报酬吸引的韩国高手们向中国玩家传

授成功经验，并实打实地建立了发现和招募人才的游戏学院和系统。

现在韩国看到了赶超的机会。去年，中国规定18岁以下人群每周玩在线游戏不得超过3小时。鉴于专业选手14岁就开始训练，每周要练习约70小时，中国的电竞运动势必会受影响。与此同时，韩国在去年废除了一个实施了十年的条例，不再禁止16岁以下青少年半夜玩网络游戏。地方政府正在投资游戏学院。韩国新任总统先前在竞选时曾访问首尔的电竞馆LoL Park，其间还询问玩家，有什么办法改变父母认为游戏让人上瘾又浪费时间的负面看法。“我们的所作所为将塑造未来。”他引用《英雄联盟》中一个角色的话说。中国的政策可能也会帮上忙。■



A taste of things to come

Plant-based proteins are no longer a side dish in diets

Their makers' place as the main course is another matter

A good vegan milk needs to look like milk and taste like milk, whether it's a fatty version, preferred by bakers, or a skimmed one, favoured by the health-conscious. And, for coffee-drinkers, it should ideally foam like the stuff from a cow. For years manufacturers have had trouble hacking this delicate imitation game. Rapidly rising revenues suggest that they are getting much better at it. In America alone, \$2.6bn of plant-based milk was sold in 2021, up from \$2bn in 2018.

Pseudo-milks are only one category in the growing assortment of passable plant-based alternatives to animal products. There are now convincing versions not just of meat but of cheese, eggs and even prawns. Burger King and McDonald's sell vegan patties; Chipotle has made a plant-based chorizo. Last year the world's largest producer of canned tuna, Thai Union, launched a plant-based line. Growing sales show the growing taste for this type of foodstuff (see chart). BCG, a consultancy, reckons that global revenues from alternative proteins could reach \$290bn by 2035—and that is a cautious estimate.

Eager investors have poured into the business like oatmilk into a latte. Alternative-protein companies lapped up \$5bn in investments in 2021, 60% more than in 2020. Oatly, a Swedish firm that makes plant-based milk, raised \$1.4bn on its Nasdaq debut last year. Impossible Foods, which makes meatless burgers, raised \$500m in November, valuing the firm at \$7bn. In February Nestlé, a packaged-goods giant, acquired Orgain, which makes plant-based protein powder, for an undisclosed sum rumoured to be around \$2bn. Can the feast last?

One reason to be hopeful is that alternative proteins have come a long way since the 1980s, when Quorn, a fungus-based meat alternative, first hit supermarket shelves. Silk, a soya milk, followed in the 1990s. Unlike those early products, which were neither terribly tasty nor particularly nutritious, the latest crop are often both. Clever processing improves texture, additives boost taste and a pinch of specially engineered peas and beans adds nutrients.

Firms are experimenting with ever more novel ingredients in search of meat- and dairy-like properties that will attract ever more shoppers. TerViva, an American startup, is using the oil of pongamia, an Asian tree, to mimic butter. ChickP, an Israeli firm, is using chickpea extracts to mimic the texture and nutritional value of eggs in mayonnaise. Firms are also getting better at turning such bounty into consumer products. There are now ways of using corn protein to make plant-based cheese alternatives melt and stretch.

Better products and lower prices—the result of both improved manufacturing techniques and scale—have coincided with the rise of “flexitarians”, who forgo meat but not always. Some are trying to cut saturated fat for health reasons—a trend fuelled by the pandemic. Fitness fanatics on faddish diets want to develop bulging muscles without building up cholesterol. Concerns about animal welfare and greenhouse-gas emissions from rearing livestock are driving the climate-conscious to limit their animal-derived intake; producing a gram of beef generates 25 times the volume of greenhouse-gas emissions as producing a gram of tofu.

For all the advantages, making a plant not taste like a plant takes work, and ultra-processed substitutes seldom match animal proteins in nutritional value. Plant-based junk food is still junk. Soya is a common allergen and can have a disruptive effect on hormones. Green-minded consumers are realising that plant-based does not necessarily mean sustainable. Farming

almonds to make a milk-like drink, for example, uses huge quantities of water. As inflation rises, even diehard flexitarians may turn into omnivores, and pick either the real deal (cheaper than faux animal proteins) or veg (cheaper still).

Plant-based proteins are also a tough sell in giant markets like India, where diets are already plant-rich, or Nigeria, where meat-eating is a sign of wealth. That limits their global appeal. And animal products, including milk, are better for children's bone development and nurturing gut bacteria, though lab-grown versions of meat and dairy are becoming more nutritious.

All this suggests that alternative proteins have far to go to replace the animal kind. The limitations may be weighing on the firms involved. Oatly's market value has fallen by about 80% since its listing, partly because of production difficulties. That of Beyond Meat, whose burgers feature in McDonald's McPlant sandwich, is down by 90% from its peak in 2019. Sales slowed in 2021 and losses widened to \$100m in the first quarter of 2022, compared with \$27m a year earlier. Plant-based foods may no longer be only an appetiser in diets, but their makers remain one in the food business. ■



一品未来

植物蛋白不再只是道配菜

它的制造商能不能成为主菜就是另一回事了

好的纯素奶要看起来像牛奶，喝起来也像牛奶——不管是面包师喜欢的高脂奶，还是注重健康的人喜欢的脱脂奶。而且，对于喝咖啡的人来说，它最好还要像奶牛产出的奶那样能完美起泡。多年来，制造商一直把握不好这个精细的模仿游戏。不过快速增长的收入表明，它们在这方面做得越来越好。仅在美国，2021年植物奶的销售额就达到26亿美元，高于2018年的20亿美元。

尚可为人们接受用来替代动物制品的植物基产品越来越多，植物奶只是其中的一种。如今能以假乱真的不仅有植物肉，还有植物奶酪、植物鸡蛋甚至植物虾。汉堡王和麦当劳开卖素肉饼；Chipotle做了一款植物基的西班牙辣香肠。去年，全球最大的金枪鱼罐头生产商泰万圣（Thai Union）设立了植物基生产线。不断增长的销量表明人们越来越喜欢这类食品（见图表）。波士顿咨询公司估计，到2035年替代蛋白质的全球收入可能达到2900亿美元——这还只是保守估计。

如同燕麦奶倒进拿铁里一般，急切的投资者一拥而入这门生意。替代蛋白质公司在2021年获得了50亿美元的投资，比2020年增加了60%。生产植物奶的瑞典公司Oatly去年在纳斯达克上市，IPO融资14亿美元。生产植物肉汉堡的Impossible Foods去年11月融资5亿美元，公司估值达到70亿美元。今年2月，包装商品巨头雀巢收购了生产植物蛋白粉的Orgain，交易金额未披露，据传约为20亿美元。盛宴能继续吗？

一个乐观的理由是，自20世纪80年代以来替代蛋白质已经取得了长足的进步，那时一种以真菌为基础的肉类替代品阔恩（Quorn）首次在超市上架。Silk豆奶随后在90年代推出。与那些既不是很好吃也不特别有营养的早期产品不同，最新的植物基产品往往能两者兼顾。巧妙的加工改善了口感，添加剂提升了口味，再稍微加点经特别改造的豌豆和菜豆增加了营

养。

为了吸引更多顾客，企业正在尝试更多新颖的原料，以求能更加接近肉类和乳制品的口感质地。美国创业公司TerViva正在使用一种亚洲产的水黄皮树的油来模拟黄油。以色列公司ChickP正在用鹰嘴豆提取物在蛋黄酱中模拟鸡蛋的口感和营养价值。企业也越来越善于把这样的物产转化为消费品。现在有一些方法可以用玉米蛋白让植物基奶酪能够融化、拉丝。

生产工艺改进和规模提升带来了更好的产品、更低的价格。这恰逢“半素食主义者”的兴起，这些人不想再吃肉，但也不是全然不吃。有些人出于健康原因想减少摄入饱和脂肪——疫情更是推动了这种趋势。追求时尚饮食的健身狂人希望在不增加胆固醇的情况下练出肌肉。因为担心动物福利以及饲养牲畜产生的温室气体排放，关心气候变化的人也在限制自己的动物源食物摄入，毕竟生产1克牛肉的排放量是生产1克豆腐的25倍。

尽管有这么多优势，但让植物吃起来不像植物要费工夫，而超加工替代品在营养价值上很少能媲美动物蛋白。植物基垃圾食品依然是垃圾食品。大豆是一种常见的过敏原，还可能会破坏体内激素平衡。关注环保的消费者开始意识到植物基不一定可持续。例如，种植杏仁来制作类似牛奶的饮料需要消耗大量的水。随着通货膨胀的加剧，即使是坚定的半素食主义者也可能变成杂食主义者，选择真正的肉（比人造动物蛋白更便宜）或蔬菜（还要更便宜）。

植物基蛋白质在印度和尼日利亚这样的大市场销路也不好。印度人的饮食中已经包含了很多植物，而在尼日利亚，吃肉是富裕的象征。这限制了它们在全球的吸引力。而且，尽管实验室培育的各种肉和奶制品越来越有营养，但包括牛奶在内的动物产品仍对儿童骨骼发育和肠道细菌的培养更有好处。

所有这些都表明，替代蛋白质要取代动物蛋白质还有很长的路要走。这些局限可能正在令相关公司承压。Oatly的市值自上市以来已经下跌了约80%，原因之一是生产困难。Beyond Meat的市值比2019年的峰值下降了

90%，它的素肉饼是麦当劳McPlant素食三明治的主要原料。2021年Beyond Meat销售放缓，2022年第一季度亏损扩大至1亿美元，而去年同期为2700万美元。植物基食品可能已不再只是饮食中的开胃菜，但它们的制造商却仍然是食品行业的配菜。 ■



Growth v debt

China's dilemma over a curious breed of financial firm

Local government financing vehicles, once the motor of growth, are under scrutiny

China's local-government financiers have a complex identity. Tasked with developing land and doing public works, they act on behalf of, and with approval from, city and provincial authorities. Yet at the same time they represent large companies, known as local-government financing vehicles (LGFVs), which have the ability to raise billions of dollars from global investors. The thousands of LGFVs around the country owed an estimated 53trn yuan (\$8.3trn, equivalent to 52% of annual GDP) in debts last year.

Conflicts of interest have naturally arisen for the bosses of these hybrid firms. In some cases they have been caught giving chummy private companies lucrative stakes in government projects. Others have used their official status to guarantee bank loans for friends. In Sichuan province a government financier was recently found to have lent out state funds to private firms at rates as high as 20% a year. In Hunan province a boss was caught charging companies that work with the government consulting and paperwork fees. Such practices might fly in the private sector—but not with anti-corruption investigators.

The central government is taking new interest in such dodgy dealings. More than 40 high-ranking officials at LGFVs have been put under investigation or detained since the start of the year. The Ministry of Finance has warned provincial authorities about the risks associated with corruption in the quasi-state sector. The renewed attention on graft at LGFVs betrays growing concerns about the role the companies play in generating economic growth, along with the piles of debt they have amassed in the process.

LGFVs are a uniquely Chinese problem. Invented in the 1990s to get round rules that banned local governments from raising debt, the companies became one of the most important sources of economic growth over the past two decades, as they carried out vast numbers of public projects. Their status as non-government entities allowed them to borrow heavily from investors in China and abroad. One of the oddities of LGFVs is that it is city and provincial authorities that are on the hook for those debts. But LGFVs' borrowings are not included in official government budgets, making it hard to gauge risk.

The latest scrutiny brings with it two complications. For a start, it comes at an awkward moment. The economy has been hit hard by recent lockdowns to contain covid-19. In response, China's leaders have announced plans for infrastructure spending this year to help achieve a lofty GDP-growth target of 5.5%. LGFVs would typically play a key role in funding and contracting much of the building activity across the country. But the crackdown on corruption and other restrictions means that managers will be less likely to take risks. Normally this would be considered a good thing. This time, however, an unwillingness to take on new projects could come at the cost of precious GDP growth at a time when the Communist Party can ill afford it.

Moreover, tighter oversight has had the unintended effect of exposing LGFVs to currency risk. The firms must gain regulatory approval to issue bonds within China. Greater scrutiny over their use of funds has led to onshore-debt issuance by LGFVs falling by 22% in the first four months of 2022, compared with the same period last year. This has pushed the companies into the riskier offshore market: dollar-bond issuance by LGFVs soared by about 150% during the same period, according to Pengyuan, a rating agency. But few of these companies earn dollar revenues, making it harder to repay the bonds. A default would send a shock wave through the bond market.

Such dangers explain why Beijing's technocrats want to reduce the importance of LGFVs, especially as local governments can now issue bonds directly, reducing the need for fiddly workarounds. For as long as the growth target is in peril, though, LGFVs will be going nowhere. ■



增长vs债务

中国在一类奇特的金融公司上进退两难

地方政府融资平台曾是经济增长的引擎，现在备受审查

中国地方政府的财政官员身份复杂。他们以省市级政府的名义行事，并获其批准，完成开发土地、建造公共工程的任务。但与此同时，他们又代表被称为地方政府融资平台的大公司，这些公司有能耐从全球投资者那里筹集到数以十亿美元计的资金。去年，全国成千上万个地方政府融资平台负债约53万亿元（8.3万亿美元，相当于全年GDP的52%）。

对于管理这些混合型公司的官员来说，利益冲突自然产生了。他们有时被发现将政府项目中利润丰厚的部分交给了关系密切的私人公司。还有一些官员利用自己的官方身份为朋友提供银行贷款担保。四川一名政府财政官员最近被发现以高达20%的年利率将政府资金借给私营企业。在湖南，有官员被查出向和政府合作的公司收取咨询费和文书费。这类操作在私营部门里可能很行得通，但在反腐调查人员那里不行。

中央政府又开始关注这些腐败交易。今年以来，已有40多名地方政府融资平台的高级官员被调查或拘留。财政部已就准国有部门的腐败风险向各省政府发出警告。从再度关注地方政府融资平台贪腐问题可以看出，人们日益担忧这类企业在推动经济增长方面扮演的角色，以及它们在这一过程中积累的巨额债务。

地方政府融资平台是中国独有的问题。这种公司诞生于上世纪90年代，目的是绕开禁止地方政府举债的规定。过去20年间，它们已成为最重要的经济增长来源之一，开展了大量公共项目。非政府实体的身份让它们能从国内外投资者那里大量借款。地方政府融资平台的一个奇怪之处在于，这些债务是和省市级政府挂钩的。但平台的借款并不在政府的官方预算之中，这让风险很难评估。

最近的审查带来两个问题。首先，时间点很尴尬。近期为抗疫而实施的封

锁对经济造成了严重冲击。作为应对，中国领导人已经宣布了今年的基础设施支出计划，以帮助实现5.5%的GDP高增长目标。在全国各地，地方政府融资平台通常会在大部分建设活动的融资和签约方面发挥关键作用。但打击腐败和其他限制措施意味着管理者们不太可能冒险。通常这会被认为是好事。但这一次，不愿承接新项目可能要付出牺牲宝贵的GDP增长这一共产党无力承担的代价。

此外，监管趋严产生了意想不到的结果：令地方政府融资平台暴露于汇率风险中。这些公司必须获监管部门批准才能在中国境内发行债券。对其资金使用更严格的审查导致这类平台在2022年前四个月的在岸债券发行量比去年同期下降了22%。这促使这些公司进入风险更高的离岸市场：根据评级机构中证鹏远的数据，同一时期这类平台发行的美元债券飙升了约150%。但这些公司基本没有美元收入，这让它们更难偿还债券。违约将给债券市场带来一波冲击。

这些危险解释了为何北京的技术官僚会想要缩减地方政府融资平台的重要性，尤其是地方政府现在已经可以直接发行债券，减少了对这种繁复的迂回融资的需求。不过，只要增长目标面临威胁，这些平台就不会有什么大变化。■



Free exchange

Should China spend more on infrastructure?

Such stimulus would be less wasteful than a recession

Rarely can so much have been used by so few. During Shanghai's long lockdown, which mercifully eased early this month, the city's impressive infrastructure stood in splendid isolation from most of the citizens it is meant to serve. The metro (all 831km of it) was eerily quiet. The two airports, which handled 120m passengers in 2019, operated at 99% below their normal level. The famous mag-lev train neither magnetised nor levitated. Six-lane highways provided an ocean of road space for handfuls of scooters. China is renowned for creating "ghost cities": new, sparsely populated districts that gradually come to life as people move into them. Shanghai's lockdown reversed this process, turning a lively metropolis into something undead.

This surreal underuse of existing infrastructure notwithstanding, the government's best hope for reviving the economy is to add more of it. Much more. Spending on transport, water conservation and renovating old neighbourhoods will be a "strong driving force" for the economy, helping to employ China's 290m migrant workers, said Li Keqiang, the prime minister, in an emergency teleconference with thousands of local officials on May 25th. The government will also "vigorously" promote 102 "major projects", listed in the country's five-year plan, such as flood prevention, ultra-high-voltage power lines and four-lane expressways—including one to a city in Yunnan renamed Shangri-La.

If Omicron resurges, recurring lockdowns may prevent China spending its way out of trouble this year. But even if everything goes to plan, a successful stimulus will raise a deeper question. Does China need all that additional infrastructure? Or will the extra spending leave behind

superfluous “white elephants”, as undisturbed by human traffic as the airports, roads and railways of locked-down Shanghai?

The question is tricky to answer, because infrastructure in China is hard to measure or even define. The definition used by the National Bureau of Statistics (NBS) often leaves out areas such as gas and electricity, as well as social sectors like education and health care. Worse, the official investment figures, designed with central planners in mind, are not consistent with modern national accounting. Nor, owing to shifts in classification and reporting thresholds, are they consistent with themselves over time. As Carsten Holz of the Hong Kong University of Science and Technology once noted, if one intended to make this data “as unusable as possible, one could probably not do a better job than the NBS does”.

In a paper published by the World Bank in 2020, Richard Herd nonetheless estimates that China’s stock of infrastructure and government capital rose from 64% of GDP on the eve of the global financial crisis in 2007 to 107% in 2016 (the most recent figure in his paper). This new prominence of infrastructure (and housing) in Chinese investment may help explain the country’s productivity slowdown over the past decade. Another measure by the IMF adds up all the investment undertaken by China’s central and local governments. According to this method, the stock of public capital was even larger: 151% of GDP in 2019, among the highest shares in the world.

Both of these measures compare the scale of China’s infrastructure with the size of its GDP. This convention makes some sense: a bigger economy needs a larger backbone to support it. Conversely, a small economy, where people are few in number or limited in their means, can fit into a smaller infrastructural frame. If few people can afford cars, flights or smartphones, a country will have less need of roads, airports and 5G towers. According to this logic, infrastructure is a kind of “input” that should be sized according to the scale of production.

But GDP is not the only relevant comparison. Indeed, saying that a country's infrastructure should be kept in proportion to its GDP is tantamount to saying that poor countries should have poor infrastructure. Some common components of infrastructure are more like amenities than inputs to production. A cleaner environment, a faster bus trip or a more comfortable train journey are things people of all income levels can appreciate. On this view, what matters is the amount of infrastructure per person, regardless of their income.

Sadly, China's infrastructure is less impressive when compared with the size of its vast population. For example, it has 120km of motorways per 1m people, compared with 179km in France and 326km in America. And it has 106km of railway per 1m people, compared with 236km in Britain and over 400km in Germany. China's metro lines are more than 20 times as long as those in France. But China's population living in cities (of over 500,000 people) is also more than 20 times as large. China also has only 4.4 intensive-care beds for every 100,000 people, according to some estimates, compared with 14 in America—a catastrophic shortage of medical infrastructure that helps explain its lack of tolerance for covid outbreaks. Indeed, there are 37 economies in the IMF's database that have a higher stock of public capital per person than China. Presumably those economies do not think that their extra infrastructure is entirely superfluous.

| *The longer road to Shangri-La*

Critics of China's proposed infrastructure stimulus worry that it will crowd out other, more productive forms of spending. But in China's covid-wracked economy, other spending is unusually weak. Without government help, the level of demand might not be enough to fully employ the country's labour and capital, including its existing infrastructure. A recession can impose the same kind of compulsory idleness on an economy as a lockdown. The time and energy that China's workers will

devote to extending power networks, waterways and roads to Shangri-La might otherwise be lost to the economy for ever. Wasteful spending is a curse in China. But underspending can be the most elephantine waste of all. ■



自由交流

中国是否应该加大基建投入？

与经济衰退相比，基建刺激造成的浪费会少些

如此大规模的空置极其罕见。谢天谢地，上海终于在月初解封了，而在漫长的封锁期里，这座城市骄人的基础设施与它本应服务的市民中的大多数人完全隔绝。整个831公里长的地铁安静得诡异。2019年客运量达1.2亿人次的两座机场的客流量比正常水平降低了99%。著名的磁悬浮列车既不通磁也没悬浮。六车道的宽阔公路上只有寥寥几辆电动车穿过。中国素以创造“鬼城”闻名：建成一个个人口稀少的新区，随着人们迁入才逐渐有了生气。上海封城颠倒了这个过程，把一个生机勃勃的大都市变成了某种鬼域。

尽管这波现有基础设施的空置令人匪夷所思，政府振兴经济的最大希望却仍然是扩大这类设施。而且还是大兴土木。5月25日，总理李克强在与数千名地方官员召开的紧急电话会议上表示，交通、水利和老旧小区改造的投入将成为经济的“强大推动力”，有助于中国2.9亿农民工的就业。政府还将“扎实”推进五年计划中列出的102项“重大工程”，例如防洪、超高压电线和四车道高速公路——其中一条公路连接云南一个更名为香格里拉的城市。

如果奥密克戎再次暴发，反复封锁可能让中国无法在今年通过扩大支出来摆脱困境。但即使一切按计划进行，成功的刺激措施也会引发一个更深层次的问题。中国真的需要更多基础设施吗？或者说，增加的支出会不会留下一大堆大而无用的面子工程，如同上海封城期间的机场、公路和铁路一般无人问津？

这个问题不好回答，因为中国的基础设施难以衡量，甚至难以定义。国家统计局使用的定义通常不包括燃气和电力等区块，也不包括教育和医疗等社会部门。更伤脑筋的是，官方投资数据是为了中央规划者设计的，与现代国民经济核算方法并不一致。由于分类和核报门槛不断变化，随着时间

的推移，这些数据自身也难以保持统一。正如香港科技大学的穆嘉（Carsten Holz）曾经指出的那样，如果目的是让这些数据“要多难用就有多难用，那恐怕谁也比不过国家统计局”。

尽管如此，在世界银行于2020年发表的一篇文章中，理查德·赫德（Richard Herd）估计，中国基础设施和政府资本的存量从2007年全球金融危机前夕占GDP的64%上升到2016年的107%（这是他论文中的最近期数据）。基础设施（还有住房）近年来在中国投资中的地位进一步上升，可能是过去十年里中国生产率放缓的原因之一。国际货币基金组织（IMF）的一项统计把中央和地方政府的所有投资汇总起来。按照这种统计方法，中国公共资本的存量还要更大：2019年占GDP的151%，居世界前列。

这两种统计都将中国的基础设施规模与其GDP相比较。这种常见的比较方式有一定的道理：经济体越大，就越需要大量基础设施来支撑。相反，一个人口较少或人民不够富裕的小型经济体只需要较小规模的基础设施。如果很少人能买得起汽车、机票或智能手机，那么一个国家需要的道路、机场和5G基站也就更少。根据这一逻辑，基础设施是一种“投入品”，其规模应当与生产规模相匹配。

但是GDP并不是唯一有意义的对照指标。如果说一个国家的基础设施应与其GDP相称，实际上就等于说穷国的基础设施就应当糟糕。一些常见的基础设施更像是便利设施而不是生产投入品。无论收入高低，所有人都喜欢更清洁的环境、更快捷的公交运输或者更舒适的火车旅行。从这一点来看，重要的是人均基础设施的数量，不论其收入水平如何。

遗憾的是，与其庞大的人口规模相比，中国的基础设施还不够完善。例如，中国每百万人拥有120公里的高速公路，而法国为179公里，美国为326公里。中国每百万人拥有106公里的铁路，相比之下，英国为236公里，德国为400多公里。中国的地铁里程是法国的20多倍，但是中国50万以上人口城市的居民总数也是法国的20多倍。据一些估计，中国每十万人只有4.4张重症监护床位，而美国为14张——医疗基础设施的灾难性短缺有助于解释中国为何无法容忍新冠疫情暴发。事实上，在IMF数据库中，有37个

经济体的人均公共资本存量高于中国。想必这些经济体并不认为它们额外的基础设施是全然多余的。

| 到香格里拉的路还长

对于中国提出的基建刺激，批评者担心这将挤占其他更有成效的支出。但在饱受疫情影响的中国经济中，其他支出异常疲软。如果没有政府的帮助，需求水平可能不足以充分利用中国的劳动力和资本，包括现有的基础设施。和封城一样，经济衰退也可以让经济陷入一种强制性的空置状态。如果不能避免衰退，中国工人为电网、水路和通向香格里拉的道路建设所投入的时间和精力将永远消失在经济之中。在中国，浪费性支出是一种顽疾。但支出不足可能才是最大的浪费。■



Hire hurdles

Is big tech's red-hot jobs market about to cool?

The industry's giants are slowing their hiring

“Can I keep the monitor and mouse?” a fired tech worker recently asked on Blind, an anonymous social-media platform where techies go to compare notes on employers. The questions used to be about how much Meta was paying or what perks Apple offered. As America's technology giants contend with supply-chain uncertainties, a looming recession and sliding share prices, many users are instead asking if the sizzling market for tech jobs is cooling.

The first sign of trouble came on April 28th. In a quarterly earnings call Brian Olsavsky, Amazon's chief financial officer, said that the e-commerce titan's warehouses were overstaffed, costing about \$2bn (9% of operating profit) in the past year. A memo leaked a week later from Meta, Facebook's parent company, said the firm was putting a freeze on new hires in most teams. Other big tech names, including Microsoft, Nvidia, Snap and Uber, have made similar noises. So far this year listed tech firms worth a combined \$3.4trn have announced hiring freezes or firings.

The commotion comes after a prolonged boom in tech jobs. During the 2010s the number of positions in America's tech industry increased by 4.4% a year on average, triple the rate of the overall economy, according to a study by the Brookings Institution, a think-tank. The pandemic turbocharged the trend. Work, leisure and shopping shifted online, boosting demand for digital services. Last year listings for tech jobs increased by over 80% compared with 2020, observes Amit Bhatia, co-founder of datapeople.io, a research firm. Demand for tech skills also surged outside the sector as companies uploaded their operations to the cloud and boosted cyber-security, making the market even tighter. The

number of applications for each tech-industry opening fell by a quarter in 2021.

Much of the jobs growth came from startups and newly listed companies. But the tech giants, too, were adding plenty of employees. Between 2020 and 2021 Amazon, Meta and Netflix all increased their full-time staff by over a fifth. The ranks at Microsoft and Alphabet swelled by 11% and 16%, respectively. That compares with a median of 3% for firms in the S&P 500 index of America's largest companies.

So far redundancies, rather than just hiring freezes, have been largely confined to startups, such as Getir, a Turkish grocery-delivery app, and newly public firms such as Peloton, a maker of web-connected exercise bikes. Sackings at established tech companies have been modest. On May 17th Netflix, a video-streamer, laid off 150 staff. The following week news broke that PayPal, a payments firm, was cutting 80 or so jobs. In both cases that was roughly 1% of their respective workforces.

Strategically important teams are protected from the measures. Microsoft's hiring slowdown applies to its software units, such as Windows and Teams, but not its fast-growing cloud business. PayPal's lay-offs affected staff researching emerging technologies, such as quantum computing, while sparing core functions. Many of the sacked Netflixers worked in marketing rather than on shows. Demand for the most prized skills, such as understanding of advanced data science, is so high that people who possess them will be sought out even in a downturn.

At the big tech companies talented employees who hint that they want to jump ship are still receiving generous counter-offers, says Greg Selker of Stanton Chase, an executive-search firm. On May 16th Microsoft said it was raising its budget for salary increases for certain workers, in an attempt to stop talent from fleeing. Amazon did something similar a few months

earlier. Tech-focused recruiters say business is perky. Indeed, the number of listings for technology-industry jobs in May and April was far higher than at the same time last year, notes Mr Bhatia.

Some analysts argue the tech industry is bigger, more mature and stable than in the go-go 1990s, which may shield its workers from the pain of previous busts. Others note that after the dot-com bubble burst in 2000, tech work began disappearing only a year after the stockmarket crash. One thing is certain: the anxiety level of posts on Blind will stay high for a while.





招聘跨栏

科技巨头火热的就业市场即将冷却？

这个行业里的巨头正在放缓招聘

“显示器和鼠标我可以带走吗？”一名被解雇的技术人员最近在Blind上问道。科技公司的员工常常在这个匿名社交平台上交流有关雇主的信息。以往大家问的都是Meta给多少薪水或苹果提供什么福利之类的问题。随着美国的科技巨头努力应对供应链不确定性、经济衰退逼近、股价下滑，许多用户转而发问火热的科技就业市场是否正在降温。

第一个不详之兆出现在4月28日。在季度财报电话会议上，电商巨头亚马逊的首席财务官布莱恩·奥尔萨夫斯基（Brian Olsavsky）称公司的仓库员工过多，过去一年这部分成本约为20亿美元（占营业利润的9%）。一周后，从Facebook的母公司Meta泄露的一份备忘录显示该公司冻结了大多数团队的新员工招聘。微软、英伟达、Snap和优步等大型科技公司也发出了类似的信号。今年迄今已有市值共计3.4万亿美元的上市科技公司宣布了冻结招聘或实施裁员。

在这番骚动之前，科技就业市场已经红火了很长时间。智库布鲁金斯学会（Brookings Institution）的一项研究显示，2010年代，美国科技行业的职位数量平均每年增长4.4%，是整体经济职位增速的三倍。新冠疫情更是加速了这一趋势。工作、休闲和购物都转至线上，刺激了对数字服务的需求。据研究公司datapeople.io的联合创始人阿米特·巴蒂亚（Amit Bhatia）观察，去年科技业发布的职位空缺比2020年增加了80%以上。随着各类企业把业务转到云端并加强网络安全，科技业之外的部门对技术支持的需求也在激增，让这个市场更加吃紧。2021年，每个科技业职位的申请人数下降了四分之一。

职位增长大部分来自创业公司和新上市的公司。但科技巨头也曾大量扩增人手。2020年至2021年期间，亚马逊、Meta和奈飞的全职员工数量均增加超过五分之一。微软和Alphabet的员工人数分别增加了11%和16%，而包含

美国500家最大公司的标普500指数公司的增幅中位数仅为3%。

目前为止，裁员（而不仅仅是冻结招聘）主要出现在创业公司，例如土耳其杂货配送应用Getir，以及新上市的公司，例如联网健身自行车制造商Peloton。老牌科技公司的裁员力度较轻。5月17日，视频流媒体公司奈飞裁员150人。之后一周，支付公司PayPal传出消息要裁减约80个职位。这两家公司的裁员数量都只占自己员工总数的1%左右。

具战略重要性的部门不受这波减员的影响。微软暂缓招聘的只是Windows和Teams等软件部门，不包括其快速增长的云业务。PayPal的裁员针对的是量子计算等新兴技术研究部门，核心职能团队未受波及。奈飞裁掉的多为营销人员，而非节目制作人员。市场对高级数据科学等最热门技能的需求巨大，即使经济走下坡路，这类人才还是会受到追捧。

猎头公司斯坦顿蔡斯（Stanton Chase）的格雷格·塞尔克（Greg Selker）说，在巨头公司，如果优秀员工流露出跳槽的意愿，仍会被以慷慨的涨薪挽留。5月16日，微软表示，为阻止人才流失，正在上调某些员工的加薪预算。亚马逊在几个月前也有类似的举措。专做技术人才招聘的猎头表示目前生意兴隆。实际上，据巴蒂亚称，今年4、5月间的科技业职位空缺远高于去年同期。

有分析师认为，如今科技业比1990年代繁荣期时规模更大、更成熟，也更稳定，可能会使业内员工得以免受以往衰退期带来的那种苦楚。也有人指出，2000年互联网泡沫破裂，股市崩溃仅一年后技术职位便开始遭裁撤。有一件事是肯定的：Blind平台上的帖子流露出的焦虑水平在一段时间内会居高不下。■



The coming downturn

A recession in America by 2024 looks likely

It should be mild—but fear its consequences

Not long ago recessions seemed to strike America roughly once a decade. But only two years after the first lockdowns, the business cycle is turning at a sickening speed and another one already seems to be on its way. If you are like most people, your memory of downturns will be dominated by the past two—the financial heart attack in 2007-09 and the pandemic-induced collapse in 2020. Both were severe and highly unusual. By their standards, America's next recession will almost certainly be milder and more pedestrian. But because the world economy, asset markets and America's politics are all fragile, it may yet have nasty and unpredictable consequences.

There is no escaping the squeeze ahead for America's economy. Surging food and petrol prices are eating into people's spending. In April consumer prices were 8.3% higher than a year earlier. Even excluding food and energy prices, annual inflation is 6.2%. Supply-chain problems could flare up for as long as war rages in Ukraine and China sticks to its zero-covid policy. The American labour market is red-hot, with nearly two job openings for every unemployed worker in March, the most since 1950, when data were first collected. A measure of wage growth by Goldman Sachs is at an all-time high of nearly 5.5%—a rate companies cannot bear unless they continue to raise prices fast.

The Fed is promising to pour water on the fire. Investors expect it to have raised interest rates by more than 2.5 percentage points by the end of 2022. The central bank is crossing its fingers, saying that it can hit its 2% inflation target without causing a downturn. But history suggests that by acting to tame inflation it will cause the economy to shrink. Since 1955,

rates have risen as fast as they will this year during seven economic cycles. In six of them recession followed within a year and a half. The exception was in the mid-1990s, when inflation was low and the labour market was more balanced. On June 1st Jamie Dimon, the boss of JPMorgan Chase, America's largest bank, warned of an approaching economic "hurricane".

In fact, although a recession is likely, it should be a relatively shallow one. In the crisis of 2007-09 the financial system froze and in 2020 activity in entire sectors ground to a halt. Both downturns saw the sharpest initial drops in GDP since the second world war. This time will surely be different. In some ways America is resilient. Consumers are still flush with cash from the pandemic stimulus and companies have been enjoying bumper profits. The housing market is slowing as rates rise but, in contrast to the late 2000s, it is not about to bring down the country's banks, which are strong. And at least the Fed does not face the predicament it did in the 1980s. Back then, inflation had been above 5% for six and a half years and it had to raise rates to nearly 20%, causing unemployment of almost 11%. Today inflation has been above target for a little more than a year. It should be easier to purge.

The trouble is that even a mild American recession would expose glaring fragilities. One is the commodity-price crisis in much of the world, the result of Russia's invasion of Ukraine. Countries from the Middle East to Asia are facing severe food shortages and soaring fuel bills. The euro zone is dealing with an especially sharp energy shock as it weans itself off Russian oil and gas. Around the world, household incomes are collapsing in real terms.

An American recession would land another blow on vulnerable parts of the global economy by curbing demand for their exports. Tighter monetary policy at the Fed and the resulting strength of the dollar would also compound what has already been the biggest sell off in emerging-market

bonds since 1994. The IMF says that about 60% of poor countries are suffering debt distress, or are at high risk of it.

Another weakness lies closer to home, on Wall Street. So far in 2022 the American stockmarket has fallen by 15%—comparable to the decline during the mild recession that started in 1991. The sell-off has been orderly and America's banks are stuffed with capital. But after over a decade of cheap money, no one can be sure how stratospheric asset prices will be affected by the combination of higher interest rates and a Fed-induced recession. Stocks are pricey relative to long-run profits.

A system of market-based lending has sprung up since 2007-09 that has yet to be severely tested. It includes investment funds that act like banks, vast derivatives clearing-houses and high-speed bond traders. If something goes wrong, the Fed will find it hard to bail out Wall Street yet again, because it will at the same time be forcing Main Street to cope with higher rates and job losses.

A final fragility is America's hyper-partisan politics. A recession would probably strike by the end of 2024, colliding with campaigning for the presidential election. If the economy is shrinking, the race for the White House in 2024 is likely to be even more toxic than expected.

Politics could distort the government's response to a recession. The Fed may be dragged into a venomous political battle. After receiving handouts amounting to 26% of GDP in the pandemic, voters and firms may expect the state to protect them from hardship this time, too. Yet the Republicans, who will probably control Congress after mid-term elections in November, would be most unlikely to spend money to see off a downturn if that also risked saving President Joe Biden.

| *From the roaring to the raging 2020s*

If America's economy does shrink in the next year or two, it could even alter the country's long-term direction. The best response to a downturn during which inflation remained high would be pro-growth reforms, such as lower tariffs and more competition. Instead, recession may fuel populism and protectionism and even return Donald Trump to the presidency. Three of the past four recessions coincided with presidential elections or shortly preceded them. Each time the party controlling the White House lost power.

Measured by the technocratic yardstick of lost GDP, the next recession could be mild. But not when judged by its impact on the emerging world, asset markets and American politics. Do not underestimate the perils that lie ahead. ■



【首文】衰退来袭

美国很可能在2024年前陷入经济衰退

应该不太严重，但不要对后果掉以轻心

还在不久前，美国似乎还是大约每十年遭遇一次经济衰退。但在首轮防疫封城过去仅仅两年后，经济周期正在以不妙的速度转向，另一次衰退似乎已箭在弦上。提起经济衰退，大多数人主要还是会想起刚过去的那两次——2007至2009年的金融体系经历的“心肌梗死”以及2020年由新冠疫情引发的经济崩溃。这两次衰退都很严重，而且非比寻常。按照这两次的标准，几乎可以肯定美国下一次衰退会相对温和，也更平淡无奇。但由于世界经济、资产市场以及美国政治都很脆弱，它仍然可能产生严重和不可预测的后果。

对美国经济来说，前方的困境已经不可避免。飙升的食品和汽油价格令人们钱包吃紧。4月的消费价格比去年同期上涨了8.3%。即使不包括食品和能源价格，年通胀率也达到了6.2%。只要乌克兰的战争持续，而中国坚持新冠清零政策，供应链问题就可能不断爆发。美国劳动力市场火热，在3月里几乎是每个失业工人对应两个工作机会，达到自1950年首次收集数据以来的最高值。高盛发布的工资增长指标接近5.5%，创历史新高——除非继续迅速提高产品价格，否则企业无法承受这样的工资增速。

美联储承诺救火。投资者预计到2022年底美联储会把利率提高2.5个百分点以上。该行正在祷告，希望能实现其2%的通胀目标却不引发衰退。但经验表明，如果它采取抑制通胀的行动，将导致经济萎缩。自1955年以来，有七个经济周期的利率升速与今年可能的速度一样快。在其中六个周期中，经济在一年半之内陷入了衰退。只有上世纪90年代中期的周期是个例外，当时通胀低，劳动力市场较为平衡。6月1日，美国最大银行摩根大通的老板杰米·戴蒙（Jamie Dimon）警告说，一场经济“飓风”正在逼近。

事实上，尽管很可能出现衰退，程度应该会相对较轻。在2007至2009年

的经济危机中，金融系统陷入停滞；在2020年，整个的行业陷入停顿。在这两次衰退的初期，GDP都出现了自二战以来的最大跌幅。这一次肯定会有所不同。从某些方面来说，美国经济具有韧性。拿到疫情补贴的消费者仍然不缺钱，企业也一直享受着巨额利润。随着利率上升，房地产市场正在放缓，但与2000年代末时的情形不同，它不会拖垮美国目前财务健康的银行。而美联储至少不是在面对上世纪80年代那种困境——当时逾5%的通胀率持续了六年半之久，它不得不将利率提高到近20%，导致失业率升至接近11%。今天，通胀高于目标一年出头，应该更容易清除。

问题在于，即使一场不算严重的美国经济衰退也会暴露出一些明显的脆弱部分。其一是俄罗斯入侵乌克兰导致世界大部分地区出现大宗商品价格危机。从中东到亚洲，许多国家都面临严重的粮食短缺和飙升的燃料账单。由于在努力摆脱对俄罗斯油气的依赖，欧元区正在应对尤其剧烈的能源冲击。在世界各地，家庭实际收入正在暴跌。

美国经济衰退将抑制它的进口需求，从而给全球经济中的脆弱部分带来又一记重击。新兴市场债券已经遭遇了自1994年以来最大的一次抛售潮，而美联储收紧货币政策以及由此带来的美元走强还会加剧这一局面。国际货币基金组织表示，大约60%的贫穷国家正在遭受债务危机或处于高风险水平。

另一个弱点就在自己家门口的华尔街。今年截至目前，美国股市下跌了15%——与1991年开始的温和衰退期间的跌幅相当。股票抛售较为有序，美国银行的资本也非常充裕。但在经历了十多年的廉价资金期之后，没人说得准加息和美联储引发的衰退的共同作用将如何影响极高的资产价格。相比长期利润，股票价格偏高。

自2007至2009年以来，一个基于市场的贷款体系迅速出现，但还没有经过严峻考验。它包括像银行那样运作的投资基金、庞大的衍生品清算所，以及高速债券交易商。如果出现什么问题，美联储会很难再次为华尔街纾困，因为与此同时它还得迫使普通民众去应对更高的利率和失业。

最后一个脆弱环节是美国严重极化的政治。经济衰退很可能会在2024年底前来袭，正赶上美国总统大选。如果美国经济正在萎缩，对2024年入主白宫的争夺战很可能比预期更险恶。

政治可能会带偏美国政府对经济衰退的反应。美联储可能会被拖入一场政治恶斗。鉴于选民和企业在新冠疫情期间获得了相当于GDP的26%的救济金，他们可能会指望这一次政府还是会保护他们免于困顿。但共和党人很可能在今年11月的中期选举后控制国会，而他们最不可能把钱花在阻止经济衰退上——如果这样做还要冒着让拜登成功连任的风险的话。

| 从咆哮到抓狂的20年代

如果美国经济在未来一两年真的萎缩了，这甚至可能改变美国的长期走向。面对一个通胀居高不下的衰退期，最好的应对措施是实行促进经济增长的改革，比如降低关税和加强竞争。而现实中衰退可能激发民粹主义和保护主义，甚至把特朗普送回白宫。最近四次经济衰退中有三次都发生在总统大选期间或大选前不久，结果掌控白宫的政党都丢掉了执政权。

以GDP损失这种技术专家使用的标准衡量，下一次衰退可能不太严重。但如果从它对新兴世界、资产市场以及美国政治的影响来评判，就不是这样了。不要低估即将来临的危险。■



Arrival of the interspecies

AI is changing the way people relate to other beings

James Bridle explains how in “Ways of Being”

Ways of Being. By James Bridle. Farrar, Straus and Giroux; 384 pages; \$30. Allen Lane; £20

Interspecies was once a technical term used in science to describe how one species got along with another. Now it is a word of more consequence: it evokes the new connections between humans and non-humans that are being made possible by technology. Whether it is satellite footage tracking geese at continental scale, or a smartphone video of squirrels in a park, people are seeing the 8.7m other species on the planet in new lights. In “Ways of Being”, James Bridle, a British artist and technology writer, explores what this means for understanding the many non-human intelligences on Earth.

Mr Bridle makes clear that three kinds of minds are now interacting: human, non-human and machine. Using artificial intelligence (AI), machines will in future have the capability to interpose themselves as translators between human and other biological life forms. The strength of machine intelligence is its rapidity, repetition and accuracy over time.

The author spots an immediate hitch: IBM, Microsoft, Amazon, Google, Facebook and other big technology firms are, he alleges, “the number one driver of climate change” and so of “global extinction”. That is overcooking it, given that the same companies build climate solutions and disseminate knowledge, and that other industries are much dirtier. What is true is that profit is the main motive for advances in AI; as yet nature does not get much of a look in, and non-human intelligences go unexplored outside zoology departments. Computing is as focused on humans as ever, even as

climate change and biodiversity-loss suggest it should devote much greater attention to other species.

The first step towards an interspecies future, Mr Bridle argues, is showing more appreciation for other forms of intelligence (the “ways of being” of his title). To some extent, this is already happening, starting with cephalopods. Through films and other initiatives many people now know that octopuses have an advanced and strange intelligence. Human beings’ last common ancestor with the octopus lived 600m years ago, compared with 16m years for the chimpanzee. Yet the octopus eye resembles the human kind. If similar eyes can evolve through separate routes, so might intelligences.

The next step, Mr Bridle asserts, is recognising that people live in an “entangled” and “more than human” world. Everything is messier than it seems. Other intelligences have developed from a common evolutionary base, and they overlap in ways that science is just beginning to discern. Mortal intelligence is not only limited by its capacity, but by its type: people are bipedal primates who see and hear better than they smell and touch.

| *Metamorphoses revisited*

To see the world like this is in some ways a return to the animism of bygone centuries, an outlook reminiscent of Ovid. Yet the territory ahead is uncharted. Science may soon crack the Rosetta Stone of animal languages. That would mean the preferences of other species are made explicit, and so may intrude into law and politics.

Because technology has helped to wreck nature, Mr Bridle finds himself surprised that the answer for drawing closer to the living world is “sticking tiny digital sensors on everything”. In time AI might move beyond translation to engage with other species. It could help in providing them with security and veterinary care, for instance, and eventually more sophisticated services; should a system be developed to ascribe value to

plants and animals, a form of digital money could even circulate across species barriers.

Teaching AI about life on Earth will require not just humans and hard drives, but the scanning and input of all the “actual intelligences” of animals, trees, fungi and brain-sized microbial colonies. Machines themselves may come to resemble natural beings, subject to the same evolutionary pressures as biological life forms, and with their own capacity for contemplative reflection.

“Ways of Being” would have benefited from sharper editing. There are many Wiki-heavy digressions in a book that could have been half the length. Yet like the randomness in nature he celebrates, Mr Bridle’s meandering is part of the effect. In making clear the patience, imagination and humility required to better know and protect other forms of intelligence on Earth, he has made an admirable contribution to the dawning interspecies age. ■



种间交流的时代来了

人工智能正在改变人类与其他生物的关系

詹姆斯·布莱德尔在《存在之道》中做了解释【《存在之道》书评】

《存在之道》，詹姆斯·布莱德尔著。Farrar, Straus and Giroux出版社；384页；30美元。Allen Lane出版社；20英镑。

种间关系曾经是一个科学术语，用来描述一个物种和另一个物种之间如何相处。现在，这个词变得更重大了：它让你想到人类与非人类之间因技术发展而产生的新的联系。无论是跨越大陆追踪大雁的卫星影像，还是用智能手机拍摄公园里小松鼠的视频，人们都在从全新的视角看待地球上870万个其他物种。在《存在之道》（Ways of Being）一书中，英国艺术家、科技作家詹姆斯·布莱德尔（James Bridle）探讨了这对于理解地球上许多非人类智慧的影响。

布莱德尔阐述现在有三种智慧在相互作用：人类、非人类和机器。凭借人工智能，未来的机器将能够置身于人类和其他生命形式之间，发挥翻译的作用。机器智能的优势是它能长久保持快速、重复且准确。

作者发现了眼下的一个症结：他称IBM、微软、亚马逊、谷歌、Facebook以及其他大型科技公司是“气候变化的头号推手”，因此也是导致“全球灭绝”的头号推手。这种说法太过夸张，毕竟这些公司都在制定气候解决方案并传播相关知识，而其他行业的污染要严重得多。真实的情况是，利润是发展人工智能的主要动机；到目前为止，大自然得到的关注并不多，人们也没在动物学以外的领域探索非人类智慧。计算技术仍然一如既往地关注人类，即使气候变化和生物多样性丧失表明它应该大幅增加给予其他物种的关注。

布莱德尔认为，迈向种间交流未来的第一步是对其他形式的智慧（即他的书名“存在之道”所指）表现出更多的赞赏。在某种程度上，人们已经这么做了，首先是对头足类动物。通过电影和其他方式，很多人现在知道了章

鱼有着奇异的高智慧。人类与章鱼最后的共同祖先生活在6亿年前，而人类与黑猩猩的共同祖先生活在1600万年前。但章鱼的眼睛与人类相似。如果不同的路径能进化出相似的眼睛，那么或许也能进化出相似的智慧。

布莱德尔主张，下一步是要认识到人们生活在一个“纷繁纠缠”而“不只有人类”的世界。一切都比看上去更混乱。其他智慧体从共同的进化基础上发展而来，而关于它们在某些方面的交叠之处，科学才刚刚开始辨别。生命体的智慧不仅受其性能的限制，还受种类的限制：人类是两足灵长类动物，视觉和听觉比嗅觉和触觉更强大。

| 重看《变形记》

以这种方式看世界，在某种程度上是回归到几个世纪前提出的万物有灵论，让人想起奥维德（Ovid）。不过前方的领域是未知的。科学可能很快就能破解动物语言的“罗塞塔石碑”。这意味着其他物种的偏好将会明确起来，因此可能会侵入法律和政治领域。

有鉴于科技推动了对自然的破坏，布莱德尔惊讶地发现，要更接近生物世界的方法是“在所有东西上都贴上微型数字传感器”。假以时日，人工智能可能不只是为与其他物种的交流提供翻译。例如，可以帮助为它们提供安全保障和兽医护理，并最终提供更复杂的服务；如果开发出能让动植物也接入价值概念的系统，某种形式的数字货币甚至可以跨越物种障碍流通起来。

教会人工智能了解地球上的生命不仅需要人类和硬盘，还需要扫描和输入动物、树木、真菌和大脑大小的微生物菌落等所有“真实智慧体”。机器本身可能也会变得像自然生物，受到与生物生命形式相同的进化压力，并具有自己的深入反思能力。

如果编辑的砍刀能更犀利些，《存在之道》应该会更出色。这本书本来只需要一半篇幅，而现在里面有很多像维基百科那样长篇大论的题外话。不过就像他赞美的大自然的随机性一样，布莱德尔的漫谈体也算形式契合了内容。他阐明了为更好地了解和保护地球上其他形式的智慧所需的耐心、

想象力和谦逊，为即将到来的种间交流时代做出了令人钦佩的贡献。 ■



Bartleby

The power of small gestures

Small acts of appreciation can delight employees. But they are not meant to be industrialised

When labour markets are tight, the perks tend to get better. Spotify is rolling out a new corporate-subscription package, enabling firms to offer the streaming service to their employees. If you are sufficiently high up at Goldman Sachs, you are now entitled to take as much holiday as you want (this is a nominal perk; no one who cherishes work-life balance gets to climb the ladder at Goldman in the first place). Salesforce has a ranch in California to which it can send workers for in-person get-togethers. If you work long enough for Blue Origin, you might get blasted into space.

For firms that don't own rockets or ranches, it can seem hard to compete. The good news is that small gestures of appreciation can have an outsized effect on employee satisfaction and loyalty. The bad news is that they are not meant to be scaled up.

Several pieces of research look at the effect that acts of thoughtfulness can have on staff. In one recent study by academics at King's College London and Harvard Business School, a group of social workers was randomly divided in two: members of one group got a letter of thanks for their work from their line manager, and members of the other got nothing. A month later, recipients of the letter reported feeling much more valued than their counterparts.

In similar vein, a study in 2010 found that university fundraisers who were personally thanked for their work by a senior member of staff made many more calls to ask alumni for donations in the week following this small act of recognition than they had in the week before. There was no statistically

significant change for an unthanked control group.

Another study involved workers at a Coca-Cola facility in Madrid, some of whom had secretly been told to perform acts of kindness to a subset of their colleagues (bringing someone a drink, say, or emailing them a note of thanks). Both givers and receivers of these acts reported feeling higher levels of job satisfaction; and the receivers ended up doing other colleagues more favours, too.

Such studies carry two lessons for employers. One is that recognition can have a meaningful impact on workers. The other is that this impact is amplified if shows of appreciation are personal and unexpected. In their haste to act on the first lesson, plenty of companies completely forget the second.

Many firms now run formal employee-recognition initiatives, from rewards programmes to award schemes. Vendors offer clients a variety of services, including internal noticeboards on which colleagues can publicly thank each other for their work and bestow points that can be redeemed for gifts and experiences. The website of one vendor offers managers advice on what to say to employees to make them feel recognised, because absolutely nothing says “authenticity” like a script. (Sample quote: “Congratulations on your great victory! Only you could have pulled it off!”, which sounds like a Hallmark card for Napoleon.)

Industrialising appreciation misses the point completely. Automated birthday and work-anniversary congratulations are about as personal as an invoice. Platforms on which peers publicly recognise the hard work of others are liable to encourage performative displays of praise. That is especially likely if every compliment shows up on an analytics dashboard for the boss; one employee-engagement firm tracks shows of gratitude and breaks these “recognition occasions” into a series of ghastly categories like

“Owning the Results” and “Building Trust Like a Family”.

Award schemes also require careful handling. They are great if you win and somewhat less motivating if you don't stand a chance. In one study from 2014, academics looked at the effect of an award programme on Zambian health-care trainees; they found that comparison with others worsened performance, especially for less able workers.

The secret to showing appreciation is that scarcity matters. It should involve effort: a handwritten note is better than an email, which is better than an algorithm. It should feel personal, not part of a scheme cooked up by the human-resources department. And it should be sufficiently rare to register as meaningful; thanking everyone for everything turns gratitude into a commodity. In other words, appreciation is not a big-data project. Individual managers can harness the power of small gestures to make a real difference to their teams. The best thing firms can do is to hire the sort of people who recognise as much. ■



巴托比

小姿态，大威力

小小赞赏能让员工欢喜，但不能变成例行公事

当劳动力市场吃紧时，公司待遇往往会变得更优厚。Spotify正在推出一种新的企业订阅套餐，让企业可以为自己的员工提供这项流媒体服务。如果你在高盛的职位够高，现在就有权随心所欲地休假（这只是一种名义上的福利，因为重视工作与生活平衡的人本来就不会在高盛获得升迁）。

Salesforce在加州有个牧场，员工可以去那里参加聚会。如果你在蓝色起源（Blue Origin）的工龄够长，还有机会被送上太空。

没有自己的火箭或牧场的公司相比之下似乎没了竞争力。好消息是，小小的赞赏姿态也可以对员工的满意度和忠诚度产生很大的影响。但坏消息是，它们并不适合大规模运用。

有几项研究分析了体贴的行为可能给员工带来的影响。在伦敦国王学院和哈佛商学院的学者近期所做的研究中，一群社会工作者被随机分为两组：一组成员收到了他们直属经理的感谢信，另一组什么也没有。一个月后，收到信的人表示自己已被重视的感觉，程度远超过另一组。

与此类似，2010年的一项研究发现，如果大学筹款人员获得某个上级人员直接向个人表达对其工作的谢意，那么在这一小小的认可举动发生后的一周里，他们打电话向校友募捐的次数比前一周明显增多。而未得到感谢的对照组在统计学上没有显著变化。

另一项研究的对象是马德里可口可乐工厂的员工，研究者私底下让其中一些人对部分同事表现出善意（例如给带杯饮料，或者发封感谢电邮）。这些行为的施予者和接受者都表示工作满意度有所上升；而接受者之后也对其他同事表现出更多善意。

这些研究给雇主们带来了两个启示。一是赞赏可以对员工产生积极影响，

二是如果赞赏直接发生在个体之间而且并不在预期之中，影响还会进一步放大。许多公司急匆匆去践行第一个，却完全忽略了第二个。

许多公司现在都在开展正式的员工嘉奖计划，包括各种奖励和表彰方案。有供应商为客户提供各种各样的服务，包括内部公告栏，同事们可以在上面彼此公开表达感谢，并赠送可以兑换礼品和体验的积分。一家供应商在网站上为公司经理提供建议，告诉他们该怎么说才能让员工感到被认可，因为绝没有比照本宣科更能体现“真心实意”的表达了。（比如：“祝贺你取得伟大胜利！只有你才能做到！”这听起来就像是写给拿破仑的贺卡。）

流水线式的赞赏完全没有抓住重点。自动发送的生日和工作纪念日祝贺就像发票一般冰冷而没有人情味。让同事在平台上公开赞扬他人的辛勤工作很容易沦为惺惺作态的互相吹捧。如果每句赞美都会显示在老板的分析仪表盘上，那就更有可能是这样了。有一家研究员工敬业度的公司追踪企业员工表达感激的情况，并把这些“赞誉时刻”划分成一系列令人发指的类别，例如“勇于负责”和“建立家人般的信任”。

奖励计划也需要小心处理。如果你拿奖了，那它们就很好，但如果你根本没有机会获奖，那它们的激励作用就要打折扣。在2014年的一项研究中，学者们研究了一个奖励方案对赞比亚医疗受训人员的影响。他们发现，与他人互相比较降低了绩效，特别是对于能力没那么出色的员工。

表达赞赏的秘诀在于稀缺。夸人要花些功夫：手写的便条比电邮好，而电邮比算法好。它应该是个性化的，而不应只是人力资源部制定的一套程序中的一部分。它还应该足够少见，才能让人感到有意义；感谢每个人做的每件事，感激就成了大路货。换言之，赞赏不是一个大数据项目。每个管理者都可以利用这些小姿态的威力，给自己的团队带来真正的改变。而公司能做的最好的事就是雇用那些能够认识到这一点的人。 ■



Crude calculations

Why the oil price is spiking again

A tightening EU embargo of Russian oil is just one explanation

In the 1970s Arab states used the “oil weapon” of embargoes to punish Western governments for supporting Israel. On May 30th the heads of the 27 EU member governments agreed to turn the weapon on themselves, as part of a fresh round of sanctions against Russia following its invasion of Ukraine. As well as cutting off Sberbank, Russia’s largest bank, from the SWIFT cross-border payment system, the package will also ban purchases of Russian crude oil and refined products, such as diesel, by the end of the year. There would, the EU said, be a “temporary” exemption for oil delivered through pipelines. The price of a barrel of Brent crude leapt above \$120 on the news, its highest level since March.

In principle, the decision is highly significant. As well as demonstrating unity, and the bloc’s willingness to bear economic pain to punish Russia, it cuts one of the few remaining trade ties with the Kremlin. It also imperils one of Russia’s most lucrative sources of foreign-currency earnings. The EU is Russia’s biggest market for crude, buying about half the country’s oil exports.

There are reasons, however, to be sceptical that the move will deprive the Kremlin of much foreign currency. For a start, the ban applies only to seaborne oil, transported via tankers. That is the price of unity: excluding oil delivered by pipelines was necessary to find a compromise with Hungary, which is both more sympathetic to Russia than most EU countries and critically dependent on the Soviet-era Druzhba pipeline (a name meaning “friendship” in Russian). Hungary imports about 65% of its crude from Russia.

Seaborne oil makes up a similar share of Europe's imports from Russia. But the ban is likely to have a limited impact on the oil market. Many tankers are already subject to "self-sanctioning" in parts of the West. Dockworkers have refused to unload ships carrying Russian cargoes and oil majors have been worried about the hit to their reputations from accepting shipments. Western financiers are stepping back from writing insurance contracts. Insurers based in Russia's allies could partly replace them, but have shallower pockets.

A big question is whether Russian seaborne crude, once placed under sanctions, will go unsold. So far Russia's oil exports have risen even as the country has come under sanctions. According to analysts at JPMorgan Chase, a bank, much of the increase has gone to India, which has not issued sanctions of its own.

Another question is whether Europe does eventually ban piped Russian oil, which is harder to redirect to other countries. Poland and Germany have said they will cease importing via the Druzhba pipeline. Yet it is hard to imagine Hungary's dropping its opposition to a wider ban. Viktor Orban, the country's populist prime minister, has demonstrated his willingness to block EU decisions before. Thanks to a hefty discount on Russian crude—the Urals benchmark is trading significantly below Brent—MOL, a Hungarian oil group, reports "skyrocketing" margins.

Partial though the embargo may be, such is the tightness of the oil market that prices still surged. Demand for fuel is strong as the pandemic subsides and consumers start driving and flying again, and as governments try to shield voters from the impact of higher energy costs. China's easing of coronavirus restrictions in recent days has also added to the thirst for oil. The prices of industrial metals, including iron ore and copper, have rallied, too.

Meanwhile, the Organisation of the Petroleum Exporting Countries (OPEC) and its allies, which include Russia, have shown little sign of increasing production just yet. The group was due to meet on June 2nd, as we went to press, and was not expected to depart from its plan to gradually increase supply to levels seen before the pandemic (although prices dipped on reports that it was mulling a plan to exclude Russia from its production targets, allowing Saudi Arabia and others to pump more to make up for any lost output).

Tight supply and robust demand together translate into higher prices for consumers at the pump. To make matters worse, a shortage of refinery capacity in America has raised prices for petrol and diesel even further than the cost of crude. The surging dollar adds to costs for Europe and emerging markets, notes Francisco Blanch of Bank of America. None of this is welcome news in an already inflationary environment. According to figures published on May 31st inflation in the euro area rose to 8.1% in the year to May, higher than economists had expected.

The Arab embargoes of the 1970s caused short-term pain for the West, but also spurred a drive for fuel efficiency that ultimately reduced its reliance on oil. European governments today may find themselves hoping that the short-term pain for consumers similarly gives way to the long-term gain of energy security. ■



粗略盘算

为何油价又大涨

欧盟收紧对俄罗斯石油禁运只是一种解释

上世纪70年代，阿拉伯国家用禁运这一“石油武器”来惩罚支持以色列的西方政府。5月30日，27个欧盟成员国首脑一致同意把这个武器用在自己身上，这是惩罚俄罗斯入侵乌克兰的新一轮制裁的一部分。除了把俄罗斯最大的银行俄罗斯联邦储蓄银行（Sberbank）排除在全球跨境支付系统SWIFT之外，这套制裁方案还包括在年底前禁止欧盟成员国购入俄罗斯原油和柴油等精炼石油产品。但欧盟表示会“暂时”豁免通过管道供应的俄罗斯石油。消息一出，布伦特原油价格升破每桶120美元，是3月以来的最高水平。

理论上，这项决定意义重大。除了显示欧盟团结一致，甘愿为惩罚俄罗斯而承受经济痛楚外，它还切断了欧盟与俄罗斯之间仅存为数不多的贸易纽带之一。此决定还危及俄罗斯最大的外汇收入来源之一。欧盟是俄罗斯最大的原油市场，购买了约一半的俄出口石油。

然而，有理由怀疑此举是否真能让俄罗斯流失很多外汇。首先，此禁令仅适用于用油轮从海上运输的石油。这是为团结所付的代价：为让匈牙利也能接受方案，欧盟必须豁免禁运经管道输送的俄罗斯石油，因为匈牙利不但比大多数欧盟国家更同情俄罗斯，而且也严重依赖苏联时期修建的德鲁日巴输油管道（Druzhba，俄语意为“友谊”）。匈牙利约65%的原油从俄罗斯进口。

海运石油在欧洲进口的俄石油中差不多也是这个占比。但该禁令对石油市场的冲击很可能是有限的。许多油轮在西方部分地区已遭遇“自发性制裁”。码头工人拒绝为装载俄石油的船只卸货，石油巨头们也担心接收俄石油会有损声誉。西方金融机构也不敢为之承保，虽然俄罗斯盟国的保险公司可以取代一部分，但它们的资金实力不如前者。

一大疑问是，新一轮制裁实施后，俄罗斯的海运原油会否滞销。迄今为止，在俄罗斯受到制裁之时，它的石油出口却在增长。摩根大通的分析师表示，大部分的增长流向了未对俄实施制裁的印度。

另一个问题是，欧洲最终是否会对经管道输送的俄石油实施禁运。要把这部分石油转运到其他国家的难度更大。波兰和德国已表示将停止通过德鲁日巴管道进口俄石油。但很难想象匈牙利会改变立场赞成扩大禁令。匈牙利的民粹总理欧尔班之前已表现出阻止欧盟决定的意愿。由于俄罗斯原油有高额折扣（乌拉尔原油价格明显低于布伦特原油），匈牙利石油集团MOL录得“一飞冲天”的利润率。

虽然禁运可能只是局部的，但因石油市场吃紧的程度仍导致油价飙升。随着疫情消退，消费者开始重新驾车和乘飞机出行，政府也力求让选民免受能源成本上升的冲击，目前对燃料的需求非常强劲。中国近期放宽了防疫限制措施，进一步刺激了对石油的需求。包括铁矿石和铜在内的工业金属价格也重振旗鼓。

与此同时，欧佩克及其盟友（包括俄罗斯）眼下还没有显示出要增产的迹象。该组织订于6月2日（本刊付印之时）举行会议，预计不会偏离它们原本的计划，即逐步提升产量至疫情前水平（但有报道称，欧佩克正在酝酿新计划，要将俄罗斯排除在生产目标之外，允许沙特阿拉伯和其他国家增加产量以弥补不足。消息传出后油价一度下滑）。

供应紧张加上需求强劲，结果就是消费者在加油站看到价格上涨。更糟糕的是，美国的炼油厂产能不足，导致汽油和柴油价格的升幅甚至高于原油成本的涨幅。美国银行的弗朗西斯科·布兰奇（Francisco Blanch）指出，美元升值增加了欧洲和新兴市场的成本。在通胀已经高企的大环境下，所有这些都不是好消息。据5月31日公布的数字，截至5月的一年里，欧元区的通胀已上升至8.1%，高于经济学家预期。

上世纪70年代的阿拉伯禁运给西方国家带来了短痛，但也促使燃油效率提升，最终减轻了对石油的依赖。今天的欧洲各国政府也许只能期盼消费者

承受的短痛最后也能换来能源安全这一长期好处。■



From Main Street to Wall Street

Stimulus cheques have buoyed America's stockmarket

Stocks most popular with retail investors rose by 14% in the two weeks after cheques were received

America's stockmarket enjoyed a steady bull run between 2009 and 2021. Although the advent of the covid-19 pandemic briefly sent stock prices down, the rebound was substantial: \$10,000 deposited into a fund tracking the s&p 500 in March 2020 would have grown to \$21,416 at the market's peak in December 2021.

Many retail investors performed much better. Tales of newly minted meme-stock millionaires who got rich backing GameStop, a video-game retailer, prompted some observers to reconsider the skills of retail investors. Might they have some strategic advantage over the pros?

One explanation may be significantly less sexy: \$800bn of stimulus cheques. A new paper by Robin Greenwood of Harvard and Jeffrey Wurgler and Toomas Laarits of New York University explores how big the effect was. They observed that from January 2020 to April 2021 an equally weighted portfolio of stocks in which retail investors were most active gained nearly 150%, against 38% for the overall market.

To discover the direct effect of the stimulus, the researchers first needed to find the precise dates on which the payments were received. As the poor spend a bigger share of their incomes than the rich, they expected the stimulus to cause large surges in spending in poor areas. Sure enough, the authors found distinct spikes following each of the three rounds of cheques.

Because the stimulus money went to individuals, not to institutional

investors, it is the most likely cause of any divergence in performance between shares favoured by small buyers and those preferred by asset managers. Just before the cheques were paid, returns among stocks with unusually high retail interest were unremarkable. In contrast, in April 2020—two weeks after the first round of “stimmies”—these shares gained 13%, whereas the overall market was up just 2%. And two weeks after Americans received another \$600 in December 2020, the same retail portfolio had surged by 24%, compared with 4% for the market as a whole.

Surveys estimate that 10-15% of the stimulus money, around \$100bn, was immediately invested in the stockmarket. The researchers found that a third round of stimulus in March 2021 had no effect, which suggests that, by then, many Americans had found something else to spend Uncle Sam’s money on.

Sources: “The economic impact of covid-19”, by Raj Chetty et al., 2020; “Stockmarket stimulus”, by Robin Greenwood, Toomas Laarits & Jeffrey Wurgler, NBER working paper, March 2022 ■



从“布衣街”到华尔街

经济刺激支票提振了美国股市

刺激支票接收后两周内，最受散户追捧的股票上涨了14%

美国股市在2009年至2021年经历了一波稳步上扬的牛市。虽然新冠疫情暴发导致股价一度下跌，但反弹势头强劲：假如在2020年3月投资一万美元购入一只追踪标普500指数的基金，那么到2021年12月股市巅峰时，这笔钱能涨到21,416美元。

许多散户投资者的战绩远不止于此。有些人因投资电子游戏零售商游戏驿站（GameStop）晋身神股百万富翁，让一些观察人士对散户投资者的身手刮目相看。他们也许比专业人士具备某些战略优势？

有一个可能明显没那么酷炫的解释：8000亿美元的经济刺激支票。哈佛大学的罗宾·格林伍德（Robin Greenwood）和纽约大学的杰弗里·沃格勒（Jeffrey Wurgler）及托马斯·拉里茨（Thomas Laarits）合著的新论文探讨了这些支票对股市的影响有多大。他们观察到，在2020年1月到2021年4月期间，大市涨幅为38%，而散户交投最活跃的一个等权重投资组合上涨了近150%。

为了解这些刺激资金的直接效果，研究人员先要确定人们收到支票的确切日期。有鉴于穷人的支出占收入的比例高于富人，他们估计这些钱的发放会令贫困地区的消费支出大增。果然，在三轮支票的每一轮发放后都发现了支出明显飙升。

由于刺激资金是发放至个人而非机构投资者，所以这是导致散户热衷的股票与资产管理青睐的股票表现分化的最可能因素。支票发放的前夕，备受散户关注的股票的回报率并不突出。但在2020年4月也就是第一轮刺激资金发放的两周后，这些股票上涨了13%，而大市只上涨了2%。2020年12月美国人又收到600美元，两周后同一批散户投资组合飙升了24%，大市为4%。

一些调查估计，刺激资金的10%至15%（约1000亿美元）被马上投入股市。研究人员发现，2021年3月的第三轮刺激资金没有这种效果，表明到了那会儿，许多美国人已经有了别的地方去花掉这些钱。

资料来源：《新冠肺炎的经济影响》，拉杰·切蒂等著，2020年；《股市刺激》，罗宾·格林伍德、托马斯·拉里茨及杰弗里·沃格勒著，美国国家经济研究局工作论文，2022年3月 ■



Business and trade

How Chinese firms have changed Africa

Chinese companies have made their mark on the African continent, in ways good and bad

Outside a bar in Fungurume, a mining town in Congo, men caked in dust spit peanut shells onto the floor. Inside, where Chinese New Year lanterns hang from the walls, Emmanuel (not his real name) explains how things changed after 2016, when a majority stake in the Tengwe Fungurume Mine (TFM) was sold by an American firm to China Molybdenum. He says the new owners tried to cut his salary and used subcontractors who recruit day labourers and eschew safety protocols. He says staff racially abused and hit Congolese workers. “We loved Americans,” he says. “We are fed up with the Chinese. They treat us with total disrespect.” In response, says Emmanuel, some colleagues went on strike and burned the Chinese flag. (China Molybdenum says it adheres to all Congolese laws and international labour standards, and that abuses “cannot possibly be happening within the TFM site.”)

Around 70% of the world’s cobalt, which is an essential mineral in the production of electric vehicles, is mined in Congo. China, which dominates cobalt refining, has a stranglehold over its production. In 2020 Chinese firms owned or had a stake in 15 of Congo’s 19 cobalt-producing mines. American officials have tried to persuade President Félix Tshisekedi to loosen China’s grip. But Chinese firms, supported by their country’s diplomats, are canny in navigating Congolese politics, lobbying not just Mr Tshisekedi but powerful politicians in mining regions.

To ordinary Congolese, the arrival of Chinese miners is another episode in a history of venal elites colluding with extractive firms to exploit the country’s immense resources—and its people. But residents of Congo’s

mining towns seem to think Chinese firms are more ruthless than Western ones. “The Chinese don’t really care about the people and the community,” says Donat Kambola Lenge, a human-rights lawyer in Kolwezi. “They just care about having relationships with people in power.”

Yet though Chinese mining in Congo is part of the story of Chinese business in Africa, it is not the only part. The extent of Chinese business interests has deepened and broadened in the past two decades. Some governments, like Congo’s, fail to use the relationship to deliver benefits to ordinary people, but others do a better job. Viewed as a whole, China’s business links reflect patterns of globalisation, not a new colonialism.

The data hint at China’s growing footprint. Annual flows of foreign-direct investment (FDI) from China rose from just \$75m in 2003 to \$4.2bn in 2020. The stock of Chinese FDI in Africa (\$44bn) is lower than Britain’s (\$66bn) or France’s (\$65bn), but slightly higher than America’s (\$43bn). The value of trade between China and Africa has risen from \$10bn in 2000 to a record \$254bn in 2021—more than four times that between America and Africa. For China that is just 4% of total trade, less than with Germany. But China has moved from being the main source of imports for just four of Africa’s 54 countries to most of them.

| *Going shopping*

African shoppers have also benefited from cheap Chinese products. In Kolwezi phone shops are emblazoned with logos from Infinix, Itel, and Tecno, all of them owned by Transsion, a Chinese firm whose phones account for almost half the sub-Saharan market, more than twice the share of Samsung, its nearest competitor. Unlike the South Korean firm’s devices, or Apple’s, Transsion’s products are designed for Africans. Its cheapest phones cost \$20, have African-language keyboards and camera exposures that are adjusted for black skin. In 2015 Transsion launched Boomplay, Africa’s most popular music-streaming service. Cobus van Staden of the

South African Institute of International Affairs, a think-tank, says that firms like Transsion have normalised business in Africa. “They have changed the discussion about the nature of the African market itself, by showing you can make a shitload of money. That is where China is a game-changer.”

McKinsey, a consultancy, estimates that there are 10,000 Chinese firms active in Africa—several times the number that are actually registered with the commerce ministry in Beijing. Almost a third of McKinsey’s sample had profit margins greater than 20%. Whereas the largest are often SOEs, around 90% are private firms. About a fifth of them are in construction. Chinese companies are thought to win around half of all African construction contracts that are tendered to foreign firms. They may benefit from state subsidies, but many simply outcompete their rivals. One Kenyan bigwig contrasts the approach of French firms, which take months to do feasibility studies and put their staff up in posh hotels, with the urgency of the Chinese, who sleep three-to-a-room to keep costs down.

Roughly a third of Chinese firms are in manufacturing. McKinsey estimates that 12% of Africa’s industrial production is accounted for by Chinese companies. Some manufacturers use Africa as a base for exports, raising hopes of African leaders who believe that, as Asians get richer, Africa will lure more labour-intensive factories. But power, labour and logistics are generally too expensive in Africa. Chinese manufacturers tend to serve mostly local markets, rather than export.

In Nigeria Chinese firms are big in the furniture, ceramics and wig industries. Some are located in special economic zones launched by the Nigerian and Chinese governments. But many have had little public help, opting simply to cluster near Chinese entrepreneurs from the same province. “We have to do it all ourselves,” one manufacturer told Yunnan Chen, a researcher for CARI, in 2020.

And Chinese firms have boosted local economies. A paper last year by Riccardo Crescenzi and Nicola Limodio of the London School of Economics used measures of night-time lighting to find a positive impact on economic activity in local areas 6-12 years after an inflow of Chinese FDI. There is also little truth in the myth that Chinese firms hire only fellow countrymen. African employees make up 70-95% of Chinese firms' workforces, according to a recent summary of the evidence.

Chinese firms help African ones. Joseph Ager, who runs a small construction firm in Nairobi, says Chinese investors are tough ("There's no bargaining; they give you the price") but "understand us Kenyans", seeing the need to give cash-poor firms payments in advance. They have boosted his social mobility, he says. "I'm not well-educated, I'm a second-born from a poor family. But I've been able to raise our living standards."

Much depends on African governments. In Benin, notes a paper in April by Folashade Soule of Oxford University, officials diligently negotiated a commercial centre for Chinese and local firms to ensure that its laws had primacy and that Chinese firms used the centre for wholesale but not retail selling, protecting local traders. "[The] successful negotiations on the business centre are an example of how African countries can sometimes exercise agency despite the asymmetrical nature of their relationships with China," says Ms Soule.

Yet not every government can push back. Africans find it hard to reach senior levels in Chinese companies. In Congo and elsewhere Chinese miners have fostered poor labour practices. In Nigeria Chinese cartels in ceramics and wigs have locked out local competitors. Environmental degradation is common. Tighter regulation of pollution in China, argues an Ethiopian businessman, is one reason why some Chinese firms move to Africa.

Africans want the Chinese to make things easier for exporters. Most countries have gaping trade deficits with China. Just three commodity-exporting countries (Angola, Congo and South Africa) accounted for 62% of Africa's exports to China in 2021. In December, at the triennial forum on China-Africa co-operation in Dakar, China pledged to raise imports from Africa, which stood at \$106bn in 2021, to \$300bn within three years. That will involve "green lanes" to help agricultural exporters.

The saga of the Kenyan avocado suggests that there is some substance to this pledge. Chinese fears of imported pests meant that, until recently, only frozen avocados were allowed in. But earlier this year China announced that it would accept fresh ones as well—expanding the number of potential exporters from two Kenyan firms with sufficient freezers to more than 100. Tiriku Shah, who runs a food company, is impressed by the help given by Chinese diplomats. "At first they were just helping the Chinese. Now they help Africans go to China as well."

Other African products have gained approval, such as Zambian blueberries and South African lemons. When Beijing imposed tariffs of up to 212% on Australian wine after Canberra's questioning of the origins of covid-19, AM Vineyards, a South African vintner, sent Shanghai hundreds of samples, tweaking the blend to find the right plonk for the Chinese palate. The first bottles arrived in China late in 2021. The internet allows Chinese consumers to buy products directly. After Alibaba hosted the Ethiopian ambassador to Beijing on a shopping live-stream, 11,200 coffee bags were sold in a few seconds.

All of which is promising. But the volume of exports remains small. China's approach to opening up African markets remains ad hoc and dependent on lobbying case-by-case. Only one African country, Mauritius, has a comprehensive free-trade deal with China. That is a reminder of how, for Beijing, its political relations with Africa are ultimately higher-priority

than its economic ones. ■



商业和贸易

中国企业如何改变了非洲

中国公司在非洲大陆留下了自己的印记，有好有坏【专题《中国在非洲》系列之二】

刚果采矿小镇丰古鲁美（Fungurume）的一间酒吧外，满身灰尘的男人们往地上吐花生壳。酒吧里的墙上挂着中国新年的红灯笼，伊曼纽尔（化名）讲述2016年后事情发生了什么变化。那一年，一家美国公司把腾科—丰古鲁美矿业公司（TFM）的多数股权出售给了洛阳钼业。他说，新老板试图削减他的薪水，还聘用招募临时工并绕开安全规程的分包商。他说，工作人员用种族歧视言语谩骂刚果工人还动手打人。“我们以前很喜欢美国人的，”他说，“现在我们受够了这些中国人。他们完全不尊重我们。”伊曼纽尔说，一些同事因此罢工了，还焚烧了中国国旗。（洛阳钼业表示它遵守所有刚果法律和国际劳工标准，虐待行为“不可能在TFM铜钴矿场发生”。）

钴是生产电动汽车不可或缺的矿物，全球约70%的钴在刚果开采。主导了钴精炼行业中国控制了其生产。2020年，中国公司拥有或持股刚果19个钴矿中的15个。美国官员试图说服刚果（金）总统齐塞克迪摆脱中国的控制。但在本国外交官的支持下，中国公司在刚果政界长袖善舞，其游说对象不仅是齐塞克迪，还有矿业区有权势的政客。

在普通刚果人看来，中国矿老板的到来只是同一种历史的再度上演：贪腐的精英阶层和采掘公司相勾结，攫取该国丰饶的资源——以及剥削其人民。但刚果矿业城镇的居民似乎认为中国公司比西方企业更加无情。“中国人并不真正关心民众和社区，”科尔维兹的人权律师多纳特·坎博拉·兰吉（Donat Kambola Lenge）说，“他们只关心与当权者拉近关系。”

不过，尽管中国在刚果的矿业是中国在非洲业务的一部分，却并不是唯一的部分。过去二十年里，中国在非洲的商业利益不断做深做大。一些政府，比如刚果政府，未能利用这种关系为普通民众带来好处，但其他政府做得更好些。从整体上看，中国的商业连接体现的是全球化模式，而非新

殖民主义。

从数据可以一窥中国日益扩大的足迹。来自中国的外国直接投资（FDI）年流入从2003年的仅7500万美元上升到2020年的42亿美元。中国在非洲的FDI存量（440亿美元）低于英国（660亿美元）或法国（650亿美元），但略高于美国（430亿美元）。中国和非洲之间的贸易额从2000年的100亿美元上升到2021年创纪录的2540亿美元，是美国对非贸易额的四倍多。对于中国来说这仅占它贸易总额的4%，低于对德国的贸易额。但非洲54个国家中，把中国作为主要进口来源地的国家已从仅仅四个增加到大多数。

| 买买买

非洲消费者也从廉价中国商品中受益。在科尔维兹，手机商店里显眼地贴着Infinix、Itel和Tecno等品牌标识，它们都来自中国公司传音，这家公司生产的手机几乎占到撒哈拉以南市场的一半，是其最接近的竞争对手三星的两倍多。与这家韩国公司或苹果的设备不同，传音的产品是专为非洲人设计的。其中最便宜的手机售价20美元，配备非洲语键盘和针对黑皮肤调整曝光度的摄像头。2015年，传音推出了非洲最受欢迎的音乐流媒体服务Boomplay。智库南非国际事务研究所（South African Institute of International Affairs）的考布斯·范施塔登（Cobus van Staden）表示，像传音这样的公司已经使非洲的商业正规化。“通过展示你可以在这里大赚特赚，它们改变了有关非洲市场本身性质的讨论。这就是中国改变游戏规则的地方。”

咨询公司麦肯锡估计，在非洲有一万家活跃的中国公司，是在北京商务部实际注册数量的几倍。麦肯锡的样本中近三分之一的公司利润率超过20%。虽然规模最大的那些通常都是国有企业，但九成左右是私营企业。其中约五分之一在建筑业。据信中国公司拿走了向外国公司招标的所有非洲建设合同的约一半。它们可能从国家补贴中受益，但许多单纯就是击败了竞争对手。一位肯尼亚大佬对比了法国公司和中国公司的做派，他说前者要花几个月做可行性研究，把员工安置在豪华酒店，而后者紧迫感十足，员工睡三人间以降低成本。

约三分之一的中国公司在制造业。麦肯锡估计，非洲工业产出的12%来自中国公司。一些制造商把非洲用作出口基地，这让非洲领导人更加相信，随着亚洲人变得更富有，非洲将吸引到更多的劳动密集型工厂。但在非洲，电力、劳动力和物流通常都过于昂贵。中国制造商往往主要服务当地市场，而不是旨在出口。

在尼日利亚，中国公司在家具、陶瓷和假发产业中举足轻重。它们有些落户在尼日利亚和中国政府设立的经济特区。但有许多都没有得到过什么政府支持，只是选择聚集在来自同一省份的中国企业家附近。“我们全得靠自己来。”一位制造商在2020年告诉中非研究院研究员陈韵楠。

中国企业也促进了当地经济。伦敦政治经济学院的里卡尔多·克雷申齐（Riccardo Crescenzi）和尼古拉·利莫迪奥（Nicola Limodio）去年发表的一篇论文使用了夜间照明指标，发现了中国的FDI流入在6到12年后对当地经济活动的积极影响。而说中国公司只雇用自己同胞的传言也并无根据。近期一项对相关证据的总结概述显示，非洲员工占了中国企业劳动力的70%到95%。

中国企业还帮助非洲公司。在内罗毕经营一家小建筑公司的约瑟夫·阿格（Joseph Ager）表示，中国投资者是强硬的（“没有讨价还价的余地；价格由他们定”），但“体谅我们肯尼亚人”，注意到需要给现金匮乏的公司提前付款。他说，它们帮他提升了社会地位。“我没有受过什么好的教育，我是一个贫穷家庭的二儿子。但我已经能提高家里的生活水平了。”

这在很大程度上有赖于非洲的政府。牛津大学的弗拉谢德·索尔（Folashade Soule）4月发表的一篇论文指出，在贝宁，官员们就一个为中国和本地企业而设的商业中心展开艰辛谈判，以确保本地法律至高无上，并且中国公司仅能将该中心用于批发而非零售，从而保护本地的贸易商。“在这个商业中心上的谈判成功显示，尽管非洲国家和中国的关系是不对等的，它们有时还是可以达成所愿。”索尔说。

但并非每个政府都有能力和中国谈判。非洲人发现自己很难在中国公司里

升到高层。在刚果等地，中国矿业公司发展出了糟糕的劳工惯例。在尼日利亚，垄断了陶瓷和假发行业的中国公司已经把本地竞争对手挡在了门外。环境退化很常见。埃塞俄比亚的一名商人认为，中国对污染的监管收紧是一些中国公司迁往非洲的原因之一。

非洲人希望中国能为出口商提供便利。大多数国家和中国的贸易逆差都很大。2021年，仅三个大宗商品出口国（安哥拉、刚果和南非）就占了非洲对华出口的62%。去年12月，在达喀尔举行的三年一度的中非合作论坛上，中国承诺在接下来的三年里把从非洲的进口额从2021年的1060亿美元提高到3000亿美元。这将包括帮助农业出口商的“绿色通道”。

肯尼亚牛油果的历程表明这项承诺是有实质内容的。中国对传入害虫的担忧使得它一直以来都只允许进口冷冻牛油果。但今年早些时候，中国宣布也将接受新鲜牛油果——潜在出口商数量从两家拥有足够多冰柜的肯尼亚公司扩大到100多家。经营一家食品公司的蒂里库·沙阿（Tiriku Shah）对中国外交官提供的帮助印象深刻，“起初他们只是在帮中国人。现在他们也帮助非洲人去中国。”

其他一些非洲产品已获准引进，例如赞比亚蓝莓和南非柠檬。在堪培拉提出对新冠病毒做溯源调查后，北京对澳大利亚葡萄酒征收了高达212%的关税，这时南非葡萄酒厂商AM Vineyards往上海发送了几百个样品，稍微调整配方以找到适合中国人口味的廉价酒。第一个批次于2021年底抵达中国。互联网让中国消费者可以直接购买产品。阿里巴巴邀请埃塞俄比亚驻华大使做客购物直播间后，11,200袋咖啡在几秒钟内售罄。

所有这些都展露出美好前景。但出口量仍然很小。中国开放非洲市场的方式仍是特事特办，依赖逐项游说。只有毛里求斯这一个非洲国家与中国签订了全面的自由贸易协定。这提醒人们，对于北京来说，它和非洲的政治关系终究比经济关系更重要。■



Debt and infrastructure

Chinese loans and investment in infrastructure have been huge

An era of big loans and big projects is coming to an end. How did it change Africa?

The Nairobi expressway curves 27km (17 miles) through Kenya's capital. Built by the China Road and Bridge Corporation, a state-owned enterprise (SOE), the road will open later this year. Under its concrete pillars, Nairobians share their views of it. Samwel Juma, a student, calls it "a project for the future" that will unclog traffic jams. But Gabriel Kihoti, a hairdresser, questions why it was a priority when the cost of food and fuel is surging. Francis Muriu, a cab-driver, calls it "a road for the rich, not the poor".

The road symbolises a shift in a key China-Africa relationship: over debt and infrastructure. In the 2000s and 2010s China's state-backed banks lent African governments billions for roads, ports or airports built by Chinese SOEs. Some deals, as in Angola and Congo, linked repayment to the extraction of natural resources. State-backed lending has since dwindled, as China seeks new funding models. The expressway's tolls, which in theory should pay for the road, are an example.

Kenyans' attitudes reflect lingering ambivalence after two decades of Chinese construction across Africa. China says this has been "win-win" for both. African leaders say China was the only country willing to meet their infrastructure needs. Critics argue that China has built white elephants, fostered corruption and encouraged indebtedness. New research suggests China has been neither the benevolent partner of propaganda nor the scoundrel of the West's imagination. It also shows that Africans can get more out of the relationship, depending on how they negotiate.

Like the West, China substantially increased its development finance to

Africa in the 2000s. Unlike the West, most of it took the form of loans at or near market rates, rather than aid. From 2000 to 2020 Chinese state financiers lent \$160bn to African governments. Whereas Western aid or World Bank lending is typically widely spread around, almost two-thirds of China's loans to Africa were for infrastructure. From 2007 to 2020, Chinese infrastructure financing for sub-Saharan Africa was 2.5 times as big as all other bilateral institutions combined.

In the 2000s African countries had more scope to borrow after debt relief from rich countries and a commodities boom. An adviser to one leader stresses the shift to multiparty democracy from the early 1990s. "You're stuck with this democracy thing and you're stuck with having to demonstrate to the voting population what you're bringing to the table." The easiest way to do this was to get China to lend and build.

Yet Western criticisms are often based on misguided assumptions. China is a big lender but rarely accounts for most African countries' debts. In 2020, the most recent year with good data, Chinese loans accounted for 17% of the stock of public debt in sub-Saharan Africa, says the China Africa Research Initiative (CARI) at Johns Hopkins University in Washington, DC. That was more than all other bilateral official creditors combined, but less than the share held by the World Bank (19%) or commercial bondholders (30%). In a paper in 2020 CARI researchers noted that China accounted for more than a quarter of public debt in only seven of 22 countries classified by the IMF as suffering "debt distress".

There is little substance to claims of "debt-trap diplomacy", in which China hoodwinks borrowers so as to seize assets. It is more accurate to say that China's hard-nosed approach conflicts with its seemingly benevolent rhetoric. China may not be a duplicitous negotiator—but it is ruthlessly self-interested. Last year AidData, a research group at William & Mary University in Virginia, examined 100 contracts between Chinese entities

and developing countries. The authors noted a “muscular” approach, with strict confidentiality clauses, requirements that China be repaid ahead of others and the use of escrow accounts. “One needs to go back to the 19th and early 20th century to find similar security arrangements in sovereign lending on the scale that we observe in our Chinese contract sample,” they concluded. In a follow-up paper, AidData found that a deal to expand Entebbe airport in Uganda required that all revenues generated by the airport for 20 years be used to pay back the loan.

| *Untransparent*

Opacity is a big problem. A paper in 2019 co-written by Sebastian Horn and Carmen Reinhart of the World Bank estimated that 50% of Chinese lending to poor countries was “hidden” from the bank and the IMF, partly because loans between parastatals may not appear on public balance-sheets. Chinese creditors are increasingly fragmented. The Export-Import Bank of China and the China Development Bank, both state-backed, once dominated lending, but more recently they have been just two entities among many.

This has made it harder for governments to resolve debt crises. Under Zambia’s former president, Edgar Lungu, finance ministers were sidelined when contracts were agreed by his office. After Hakainde Hichilema replaced Mr Lungu last year, a study by CARI found that the debt Zambia owed China was twice previous estimates. It included debts to at least 18 different Chinese lenders.

When China renegotiates debts, it prefers pushing back repayment dates to taking “haircuts” on the principal. Angola, which has borrowed more from China than any other African country, has been granted a three-year stay, says Vera Daves de Sousa, its finance minister. China was “very open” about extending the term, “but very reluctant to adjust the payments”. Mr Horn and Ms Reinhart argue that China’s can-kicking risks hobbling African

economies, much as Western governments did in the 1980s and 1990s.

A chapter in “Banking on Beijing”, co-written by Bradley Parks of AidData, suggests that the average Chinese project raised growth by 0.41-1.49 percentage points after two years—a large boost. The authors find that in areas around a project night-time light (a sign of economic activity) increased by 8%. Often the most effective projects are unglamorous, such as a road linking Nairobi to nearby Thika. Yet whether the loans could be put to better use is another question. China prides itself on a “demand-driven” approach: doing what African leaders want, to hell with technocrats in finance ministries. In Congo the “deal of the century” signed with Joseph Kabila in 2007 swapped mining rights for infrastructure projects. In Ethiopia China helped Meles Zenawi’s push for industrialisation. In Kenya China supported Uhuru Kenyatta’s “Vision 2030”, notably via the standard-gauge railway (SGR), its largest infrastructure project since independence.

African leaders say China works at a speed to match their needs, at least electorally. Abdoulaye Wade, a former president of Senegal, claims “A contract that would take five years to discuss, negotiate and sign with the World Bank takes three months when we have dealt with Chinese authorities.” The average infrastructure project in the Belt and Road Initiative (bri), which 43 African countries have signed, takes 2.8 years, roughly a third of the time needed by the World Bank or the African Development Bank.

Yet indulging African politicians does not always produce optimal deals for citizens. The SGR “will never pay for itself”, says Kwame Owino, of Kenya’s Institute of Economic Affairs, a think-tank. Chinese projects favour leaders’ political bases, notes “Banking on Beijing”. A province from which an African leader comes typically receives 70% more funding from China than one that has no such luck. In election years it gets 134% more. World Bank projects show no such bias.

China also facilitates corruption. The “deal of the century” in Congo was reported to include millions of dollars for the family of Mr Kabila. The mix of venal African politicians and Chinese money can often be malign. In Zambia, say two sources, Chinese contractors have identified road projects with politically connected figures and inflated the cost to boost profits and kickbacks. That has affected the quality of the work. “You have the road,” says Caleb Fundanga, a former central-bank governor, “but not the road you wanted at the beginning.”

In a paper in 2018 Ann-Sofie Isaksson and Andreas Kotsadam looked at opinion-survey data from Chinese projects in 29 African countries. They found that local residents reported increases in corruption, which did not happen with World Bank schemes. The finding “seems to signify that the Chinese presence impacts norms,” concluded the authors.

Africans see their governments as responsible for corruption. “I blame ourselves for choosing bad projects; I don’t blame the Chinese,” says David Ndi, a Kenyan economist. Yet a Western diplomat reckons China has caused the “institutional degradation” of African countries. Mr Parks of AidData suggests that “There is a tension between efficacy and safety in Chinese development finance, and some countries are more effective than others at managing these risks and rewards.”

Since a peak in 2016 China has reduced lending to Africa. In 2020 just \$1.9bn in loans went to African governments, the lowest since 2004. This partly reflects the pandemic. But it also shows how both China and Africa now place more emphasis on other parts of their economic relationship: trade and investment. ■



债务和基建

中国的贷款和基础设施投资规模巨大

一个大贷款、大项目的时代即将结束。它是如何改变非洲的？【专题《中国在非洲》系列之一】

内罗毕高速公路穿过肯尼亚首都，蜿蜒27公里。这条路由国有企业中国路桥公司承建，将于今年晚些时候通车。站在它的混凝土支柱下，内罗毕人谈了谈自己对它的看法。学生萨姆韦·朱马（Samwel Juma）称它为“面向未来的项目”，将缓解交通拥堵。但理发师加布里埃尔·基霍蒂（Gabriel Kihoti）质疑为什么在食品和燃料成本飙升的情况下先搞这个。出租车司机弗朗西斯·穆里乌（Francis Muriu）称其为“富人的路，而不是穷人的路”。

这条公路象征着一种重要的中非关系——关乎债务和基础设施——发生了转变。在2000年代和2010年代，中国的国有银行向非洲政府提供了数十亿美元，用于中国国有企业建造的道路、港口或机场。一些交易（如在安哥拉和刚果的交易）把还款与开采自然资源联系起来。随着中国寻求新的融资模式，国家支持的贷款已经减少。高速公路的通行费就是一个例子，在理论上应该能够偿付修路的费用。

中国在非洲进行了20年的建设之后，肯尼亚人的态度反映了挥之不去的矛盾心理。中国说这种建设对双方来说是“双赢的”。非洲领导人表示，中国是唯一愿意满足其基础设施需求的国家。批评者认为，中国建造了一堆昂贵无用的东西，助长了腐败并刺激了更多的负债。新的研究表明，中国既不是自己宣传中乐善好施的伙伴，也不是西方想象中的恶棍。它还表明，非洲人可以从这种关系中获得更多收益，这取决于他们如何谈判。

与西方一样，中国在2000年代大幅增加了对非洲的发展资金。与西方不同的是，其中大部分以市场利率或接近市场利率的贷款形式出现，而不是作为援助。从2000年到2020年，中国国家金融机构向非洲政府提供了1600亿美元的贷款。西方援助或世界银行贷款通常广泛分布在各行各业，

但中国向非洲提供的贷款中近三分之二用于基础设施建设。从2007年到2020年，中国对撒哈拉以南非洲的基础设施融资规模是所有其他双边机构总和的2.5倍。

在2000年代，经历了富国的债务减免和大宗商品的繁荣之后，非洲国家有了更大的借贷空间。一位领导人的顾问强调了1990年代初以来向多党制民主的转变。“你被民主这个东西所困，你不得不向投票人展示你带来了什么。”最简单的方法是让中国放贷和建设。

然而，西方的批评往往基于错误的假设。中国是一大贷款国，但在大多数非洲国家的债务中都不占大头。华盛顿特区约翰霍普金斯大学的中非研究所（CARI）表示，在2020年，即有良好数据的最近一年，中国贷款占撒哈拉以南非洲公共债务存量的17%。这超过了所有其他双边官方债权人的总和，但低于世界银行（19%）或商业债券持有人（30%）持有的份额。在2020年的一篇论文中，CARI的研究人员指出，在被国际货币基金组织归类为遭受“债务危机”的22个国家中，中国占公共债务的四分之一以上的仅有七国。

有人说中国搞“债务陷阱外交”，即蒙骗借款人以攫取资产，这种说法缺乏根据。更准确的说法是，中国强硬的态度与其看似仁慈的言辞相矛盾。中国可能不是个奸诈的谈判者——但它的利己冷酷无情。去年，弗吉尼亚州威廉玛丽大学的研究小组AidData研究了中国实体与发展中国家之间的100份合同。作者注意到了一种“肌肉发达”的手段，包括严格的保密条款、要求先于其他国家偿还中国债务以及使用托管账户。他们总结说：“你得回到19世纪和20世纪初，才能找到与我们在中国合同样本中观察到的程度类似的主权贷款安全安排。”AidData在后续文件中发现，一项扩建乌干达恩德培机场的交易要求该机场20年内产生的所有收入都用于偿还贷款。

| 不透明

不透明是一个大问题。世界银行的塞巴斯蒂安·霍恩（Sebastian Horn）和卡门·莱因哈特（Carmen Reinhart）在2019年共同撰写的一篇论文估计，中国对贫穷国家的贷款中有50%对该行和国际货币基金组织“不可

见”，部分原因是半国营企业之间的贷款可能不会出现在公共资产负债表里。中国债权人越来越分散。国家支持的中国进出口银行和国家开发银行曾一度主导放贷，但最近它们只是众多实体中的两个而已。

这使政府更难解决债务危机。在赞比亚前总统埃德加·伦古当政时，若他的政府同意签署合同，财政部长们被排除在外。哈凯恩德·希奇莱马接替伦古后，CARI的一项研究发现，赞比亚欠中国的债务是之前估计的两倍。其中包括对至少18家不同的中国贷方的债务。

当中国重新谈判债务时，它更愿意推迟还款日期，而不是减免本金。安哥拉财政部长维拉·戴夫斯·德·索萨（Vera Daves de Sousa）说，安哥拉从中国借的钱比任何其他非洲国家都多，因此获得了三年的缓缴期。中国对延长期限“非常开放”，“但非常不愿意调整付款额”。霍恩和莱因哈特称，中国这种不断推迟问题的做法可能会阻碍非洲经济发展，就像西方政府在1980和1990年代所做的那样。

AidData的布拉德利·帕克斯（Bradley Parks）参与合著的《与北京做银行业》（Banking on Beijing）中的一章表明，中国项目平均在两年后将增长提高了0.41到1.49个百分点——一个巨大的推动力。作者发现，在一个项目周围的区域，夜间灯光（经济活动的标志）增加了8%。最有效的项目往往都很乏味，例如连接内罗毕和附近的锡卡的道路。然而，能否更好地利用这些贷款是另一个问题。中国对其“需求驱动”的方式引以为豪：做非洲领导人想做的事，让财政部的技术官僚见鬼去吧。在刚果，2007年与约瑟夫·卡比拉签署的“世纪交易”用采矿权换取基础设施项目。在埃塞俄比亚，中国帮助梅莱斯·泽纳维推动工业化。在肯尼亚，中国支持乌呼鲁·肯雅塔的“2030年愿景”，特别是通过建造标准轨距铁路（SGR），这是该国独立以来最大的基础设施项目。

非洲领导人说，中国的工作速度可以满足他们的需求，至少对选举而言是这样。塞内加尔前总统阿卜杜拉耶·韦德称，“需要五年才能与世界银行讨论、谈判和签署的合同，换做中国当局只需要三个月。”43个非洲国家签署的“一带一路”基础设施项目平均耗时2.8年，约为世界银行或非洲开发

银行所需时间的三分之一。

然而，满足非洲政客并不总会为民众带来最好的交易。智库肯尼亚经济事务研究所的夸梅·奥维诺（Kwame Owino）说，SGR“永远无法为自己买单”。《与北京做银行业》指出，中国项目有利于领导人的票仓。非洲领导人的出生地从中国获得的资金通常比没有这种好运的省份多70%，在选举年会多134%。世界银行的项目没有表现出这种偏向。

中国还助长了腐败。据报道，刚果的“世纪交易”包括为卡比拉的家人提供数百万美元。贪婪的非洲政客配上中国资金往往会造成不良结果。两名消息人士称，在赞比亚，中国承包商已经和有政治关系的人物敲定了道路项目，并夸大了成本以提高利润和回扣。这影响了工程的质量。“你确实建成了一条路，”前央行行长卡力布·芬丹加（Caleb Fundanga）说，“但不是你一开始想要的路。”

在2018年的一篇论文中，安-索菲·伊萨克松（Ann-Sofie Isaksson）和安德里亚斯·科萨丹姆（Andreas Kotsadam）研究了针对29个非洲国家的中国项目的民意调查数据。他们发现当地居民报告称腐败现象有所增加，而世界银行的项目并未发生这种情况。作者总结说，这一发现“似乎表明中国的存在影响了行为规范”。

非洲人认为他们的政府应对腐败负责。“我认为错在我们自己选择了糟糕的项目；我不怪中国人。”肯尼亚经济学家戴维·恩迪（David Ndi）说。然而，一位西方外交官认为，中国造成了非洲国家的“制度退化”。AidData的帕克斯表示，“中国开发性融资的有效性和安全性之间存在矛盾，一些国家在管理这些风险和回报方面比其他国家做得更好。”

自2016年达到顶峰以来，中国减少了对非洲的贷款。2020年，只有19亿美元的贷款流向了非洲各国政府，这是自2004年以来的最低水平。这在一定程度上反映了疫情的影响。但它也显示了中国和非洲现在如何更加重视经济关系的其他部分：贸易和投资。■



Fortified but not enriched

China is trying to protect its economy from Western pressure

The results are mixed

In a message to Chinese aerospace engineers and researchers for “Youth Day” earlier last month, President Xi Jinping shared his ambitions for the industry. Young workers should advance the cause of Chinese self-reliance, he said, following in the footsteps of their predecessors who developed a home-grown nuclear weapon, missile and satellite, with little help from outsiders, in a campaign in the era of Mao Zedong called “Two bombs, one satellite”.

On the face of things, this is an odd message to trumpet in the country that has benefited more than any other from the most recent wave of globalisation. In 2000 China was the biggest merchandise trading partner of only a tiny number of countries. Now it is the biggest partner of more than 60. Between 1985 and 2015 Chinese exports of goods to America rose by a factor of 125. Partly as a result of the associated manufacturing boom, growth in China’s GDP per person averaged more than 8% a year from 2001 to 2020.

But the Chinese government has never been completely comfortable with globalisation, whatever the benefits. The process of “reform and opening up” started by Deng Xiaoping in the 1970s, under which China liberalised production and trade, has always been piecemeal and partial. The Communist Party does not intend to relinquish a commanding role in the economy. It worries about the infiltration of Western ideas. Foreign capital and expertise have therefore been courted and rewarded, but also circumscribed and often resented.

Mr Xi’s calls for self-reliance reflect his view that the balance of

globalisation's risks and rewards has changed. He believes that China has become too dependent on liberal democracies, including Europe and Japan but especially America. One risk is that the West might experience another economic slowdown similar to the financial crisis of 2007-09, sapping demand for Chinese goods and services. Another, made much more vivid by the sanctions imposed on Russia after its invasion of Ukraine, is that Western countries might use their economic power to weaken China.

To ward off such perils, Mr Xi wants to change China's place in the world economy. To oversimplify a little, there are two interrelated elements to what Mr Xi terms "becoming strong". The first is to build a commanding position in industries the government considers strategic—tech and energy, for the most part—so that no one can thwart China's economic rise. China knows that its crucial role in global supply chains helps keep its autocratic system safe from foreign attacks. The second objective is for China to rely less on potentially hostile Western partners for trade and finance, and to develop new and better ones closer to home. The Belt and Road Initiative, a huge global infrastructure development strategy, is just one method by which China hopes to find new economic friends.

| *Make, don't buy*

China has had some success with the strategic industries. Research published by Goldman Sachs in 2020 found that China's self-sufficiency in high-tech products was broadly improving (see chart 1). In many industries domestic production has caught up with domestic demand, meaning that China needs fewer products from abroad. Indeed, after hitting an all-time high in 2004-06, China's imports of goods and services have fallen sharply relative to its GDP (see chart 2).

In few industries has the push for self-sufficiency borne more fruit than in solar energy. China accounts for over 70% of the production of the raw materials used to manufacture solar cells, but also the cells themselves,

and the modules into which they are assembled. Dan Wang, an analyst at Gavekal Dragonomics, a research firm, suggests that China's lead in solar technology is likely to be irreversible. The same is true of batteries for the booming electric-vehicle industry. Wind energy is going gangbusters too. China added more offshore-wind capacity in 2021 alone than the rest of the world managed in the prior five years put together.

In fact, China has come to dominate many businesses in this way. The Economist looked at export data for 120-odd global manufacturing industries. We estimate that in 2005 China was ascendant (defined as a share of global exports of more than a quarter) in 42% of them. In 2019 that hit 67%, a record. The share of export markets that China dominated—which we define as a market share of more than half—tripled over the same period, to a third.

Yet in many important respects China's drive for self-reliance has disappointed. Even as Mr Xi has reduced China's overall import bill, relative to GDP, he has struggled to reduce its dependence on foreign components used to make high-tech goods. China spent 2.7% of GDP on imported components for electronics when he came to power in 2012, and 2.6% in 2020. Its overall bill for imports requiring large amounts of research and development has dropped only slightly.

What is more, China relies heavily on geopolitical rivals for supplies of such goods, including Taiwan and Western democracies. In aviation and spacecraft—the object of Mr Xi's calls for self-reliance earlier last month—the democratic world still supplies 98% of China's imported components.

China is also increasingly dependent on foreign expertise. The vast majority of Chinese patent filings are home-grown, but the share involving foreigners has risen from 4.8% to 5.9% since 2012. Scientists based in the

EU, Japan and America are increasingly common partners with Chinese inventors, even as Western companies and universities talk of disengaging from China to try to stop industrial espionage. In 2020 China was responsible for 8.4% of total global cross-border payments for the use of intellectual property, an all-time high.

Mr Xi's second big objective—finding better trading and investment partners—is another mixed bag. Take trade. China has eagerly befriended Russia, which has been shunned by the West. It has also embraced the Regional Comprehensive Economic Partnership, a fairly shallow but broad trade deal involving 15 Asian countries that account for almost a third of global GDP. It has applied to join the rump of the Trans-Pacific Partnership, an ambitious trade pact conceived by America but then abandoned by it.

In a survey of policymakers, business leaders and other grandees from South-East Asia published earlier this year, 77% of respondents named China as the most influential economic power in the region. “I see East and South-East Asia increasingly being pulled within the sphere of the gravitational force of the Chinese economy. That is inevitable,” says Henry Gao of Singapore Management University.

| *Overlapping spheres*

Yet big Western economies continue to exert a pull on China. The Economist gathered data on stocks of foreign direct investment (FDI—takeovers of companies and the construction of factories), portfolio investment (purchases of stocks, bonds and the like) and international trade for nearly 120 countries. For each indicator we ranked every country based on the strength of its bilateral relationship with China, then combined the rankings.

The countries with which China has the closest economic relationships are all still Western or Western-leaning: America, South Korea, Singapore,

Germany and Japan. And during Mr Xi's rule most Western economies have become more intertwined with China's. The stock of German FDI in China has more than doubled, for instance. Chinese long-term investors have doubled their gross exposure to Australia, even as politicians in both countries hurled invective at each other. Meanwhile China's ties with countries that might be expected to fall within its sphere of influence, such as Indonesia and Russia, have weakened.

China's export industries also remain highly dependent on Western demand for their wares. In the decade before Mr Xi came to power the share of Chinese goods exports that were destined for the EU, Japan and America had fallen from 50% to 39% (see chart 3). But since then no further progress has been made. Countries with which China would like to develop closer trading relationships are simply too small to replace the huge markets of America, Europe and Japan. It is difficult simultaneously to produce more high-tech goods and services and to expect the share of them sold to poorer countries rather than rich ones to increase. Despite all the warm handshakes Mr Xi shares with Vladimir Putin, Russia's president, Russia buys just 2% of China's exports.

In recent years China has been trying to develop closer financial ties with countries it believes to be sympathetic to its objectives. This includes an attempt to promote the use of its currency internationally. The idea is to reduce China's dependence on the dollar, and thus to become less vulnerable to American financial sanctions. To this end China has slowly opened its bond market to foreign investors. In the early 2010s the central bank began signing agreements on yuan-denominated swaps (ie, emergency lines of credit) with other central banks. It has also been working hard to develop a digital yuan, which is intended to make trade using the currency faster and easier to monitor. Chinese firms have been paying for imports of Russian commodities in yuan this year, which helps Russia by diminishing the impact of Western sanctions while also raising

the yuan's international profile.

But China's financial links with its near abroad remain weak. Take its bond market. A new paper by four economists, Christopher Clayton, Amanda Dos Santos, Matteo Maggiori and Jesse Schreger, examines private investors' holdings of yuan-denominated bonds. In recent years the vast majority of inflows into these assets have come from America, the euro zone and Japan. A paper published in 2018 by Camilo Tovar and Tania Mohd-Nor of the IMF examined the importance of the yuan to other currencies (ie, how much one influences the other). The researchers find "no evidence to suggest that the [yuan] is the dominant currency in Asia, by influencing exchange rates in the region or through Asian supply chains".

China's push for a more self-sufficient economy, in short, has not been entirely successful in its own terms. What is more, the attempt to create one has thrown up a series of contradictions. The desire to promote the use of the yuan abroad, for example, clashes with efforts to insulate China from global financial swings. The resulting muddle has left China neither much of a force in global finance nor protected from movements in markets beyond its control. The Chinese currency's share in cross-border payments recorded by SWIFT, a financial-messaging network, is around 2% most months, as it has been for most of the past five years. Even that overstates the currency's reach, since most transactions involving the yuan outside of mainland China take place in Hong Kong, which is part of China but uses a different currency.

On a global scale the yuan is an "anchor" for few other currencies (see chart 4). The number of new yuan-denominated swaps agreed by the central bank has slowed sharply. Research published last year by Michael Perks, Yudong Rao, Jongsoon Shin and Kiichi Tokuoka, all of the IMF, found that the Chinese banking system still plays a tiny role in global finance compared with America's (see chart 5). A new paper by Yi Fang of the

Central University of Finance and Economics, in China, and colleagues, finds that Chinese markets “are more influenced by the financial markets in the G7 economies than the other way around”. When America sneezes the rest of the world catches a cold. When China sneezes, most countries brush it off.

Another tension in China’s push for self-reliance concerns productivity. Total factor productivity (ie, the amount of output per unit of labour and capital) has barely grown under Mr Xi, a marked deceleration from before the financial crisis (see chart 6). The government believes that aiming for self-sufficiency in high-tech industries will encourage innovation and so boost productivity. In fact, the opposite is more likely. In its efforts to boost domestic champions and spur trade with friendly countries, the government will probably end up conferring advantages on firms that are not the most efficient or capable suppliers of a given product, thereby denting productivity. Because lifting productivity is the only lasting way to raise living standards, that is a worrying prospect.

Taken alone, either of Mr Xi’s ambitions—whether fortifying China against economic and technological vulnerabilities or finding a more reliable set of partners for trade and investment—would be a massive undertaking. Taken together, they are already generating contradictions, and more are likely to emerge. Trade and investment create mutual benefit and therefore mutual vulnerability by their very nature. China’s leaders are right that dependence on Western technology, markets and financial plumbing leaves them exposed, but wrong if they imagine they can escape this predicament. The only alternative to interdependence is immiseration, whatever Mr Xi tells China’s rocket scientists. ■



高筑墙，难富强

中国正试图保护自身经济免受西方挤压

结果好坏参半【深度】

上月初，中国国家主席习近平在给航空航天工程师和科研人员的“青年节”寄语中，谈到了他对航天业的厚望。他表示，青年工作者应该追随先辈们的脚步，继续推动中国的自立自强。在毛泽东时代发起的那场被称为“两弹一星”的运动中，那几代人在几乎没有外界帮助的情况下自主研发了核弹、导弹和卫星。

表面上看，作为一个从最近一次全球化浪潮中获益比谁都多的国家，宣扬这样的理念有些奇怪。2000年，中国只是零星几个国家的最大商品贸易伙伴，现在已是60多个国家的最大贸易伙伴。从1985年到2015年，中国对美国的商品出口增长了125倍。受此带动的制造业繁荣在一定程度上推动了人均GDP的增长——从2001年到2020年，中国人均GDP的平均年增速超过8%。

但无论怎样受益，中国政府从来不曾对全球化完全感到自在。邓小平在上世纪70年代开启“改革开放”，让中国放开了生产和贸易，不过这个进程一直都是零敲碎打、局部片面。共产党不打算放弃自己对经济的统领地位。它担心西方思想的渗透。因此，外国资本和专业技术一方面被追逐和奖励，一方面也受到限制，常常还招致厌憎。

从习号召自立自强可以看出他认为全球化的风险和回报的平衡已经改变。他认为中国已经变得过于依赖自由民主国家，包括欧洲和日本，但尤其是美国。一个风险是，如果西方经历又一次类似2007至2009年金融危机的经济放缓，就会削弱对中国商品和服务的需求。另一个风险是西方国家可能会利用其经济实力来削弱中国，这一点在俄罗斯因入侵乌克兰而遭受制裁后变得大为清晰。

为避免这些危险，习想要改变中国在世界经济中所处的地位。粗略地说，

他所说的“强起来”包含两个相互关联的元素。首先是在政府认为具有战略意义的行业——主要是科技和能源——占据制高点，这样就没人能阻止中国的经济崛起。中国知道自己在全球供应链中扮演的关键角色有助于保护其威权制度不受外国攻击。第二个目标是中国要在贸易和金融方面减少依赖有可能成为敌手的西方伙伴，并在周边地区发展更好的新伙伴。庞大的全球基础设施发展战略“一带一路”倡议正是中国希望找到新经济伙伴的方法之一。

| 自制，不外购

中国在这些战略性产业上取得了一定的成功。高盛在2020年发表的研究发现，中国高科技产品的自给率正广泛提升（见图表1）。在许多行业，国内生产已经能够满足国内需求，意味着中国需要从国外进口的产品减少了。事实上，在2004至2006年间创下史上最高记录后，中国商品和服务进口占GDP的比重已经大幅下降（见图表2）。

在力争自给自足的过程中，几乎没有哪个行业比太阳能行业收效更大。中国不仅生产了全球70%以上的太阳能电池的原材料，还有太阳能电池本身以及电池组件。研究公司龙洲经讯（Gavekal Dragonomics）的分析师王丹（音译）认为，中国在太阳能技术方面的领先地位很可能无法撼动。用于蓬勃发展中的电动汽车产业的电池也是如此。风能的发展同样势如破竹。中国在2021年一年里新增的海上风电装机容量超过了世界其他国家此前五年的总和。

事实上，中国通过自给自足已经在很多行业占据了主导地位。本刊研究了全球大约120个制造行业的出口数据。我们估计，2005年，中国在其中42%的行业占有优势（出口占全球出口额的四分之一以上）。2019年，这一比例达到了创纪录的67%。中国主导的出口市场（占全球一半以上份额）比例在同一时期增长了两倍，达到了三分之一。

然而在许多重要方面，中国为自立自强所做的努力令人失望。在习降低了中国总进口额占GDP比重的同时，却难以减少中国对制造高科技产品所需的外国零部件的依赖。2012年他上台时，中国进口电子元器件的支出占

GDP的2.7%，到2020年为2.6%。在那些需要大量研发投入的进口商品上的总支出只是略微下降。

更麻烦的是，中国大陆严重依赖地缘政治对手供应这类商品，包括中国台湾和西方民主国家。拿习5月初号召实现自立自强的航空航天业来说，中国98%的进口零部件仍然来自民主国家。

中国也越来越依赖外国技术。中国的专利申请绝大多数由本国人提出，但自2012年以来，有外国人参与的专利比例已从4.8%上升至5.9%。来自欧盟、日本和美国的科学家也在越来越多地与中国的发明家合作，尽管与此同时西方企业和大学也在谈论与中国脱钩，以防止产业间谍活动。2020年，中国为使用知识产权而跨境支付的款项占全球总金额的8.4%，创历史新高。

习的第二大目标——找到更好的贸易和投资伙伴——同样喜忧参半。以贸易为例。中国热情地与西方国家避之不及的俄罗斯交好。它还积极参与了《区域全面经济伙伴关系协定》（RCEP），这项贸易协定深度不足但范围广泛，参与其中的15个亚洲国家几乎占到全球GDP的三分之一。中国已经提出申请加入《跨太平洋伙伴关系协定》（TPP）的缩减版。这项雄心勃勃的贸易协定由美国构想，但后来又被美国舍弃。

今年早些时候发布的一项调查询问了东南亚各国的政策制定者、商界领袖和其他重要人物，其中77%的受访者将中国列为该地区最具影响力的经济大国。“我认为东亚和东南亚正不断地被拉进中国经济的引力范围。这是不可避免的。”新加坡管理大学（Singapore Management University）的高树超表示。

| 你中有我，我中有你

然而，西方大经济体仍对中国有影响力。本刊收集了近120个国家的外国直接投资（收购公司和建设工厂）存量、间接投资（购买股票、债券等）和国际贸易的数据。针对每项指标，我们根据各国与中国的双边关系的强弱给这些国家排名，然后再进行综合排名。

与中国经济关系最密切的依然是西方国家或倾向西方的国家：美国、韩国、新加坡、德国和日本。而且，习在任期间，大多数西方经济体与中国的经济联系变得更加紧密。例如德国对华直接投资存量增加了一倍以上。就在中国与澳大利亚政客相互谩骂之时，中国长期投资者在澳大利亚的总敞口还翻了一番。与此同时，中国与印尼、俄罗斯等可能让人以为属于它引力圈的国家的经济关系却有所减弱。

中国的出口行业同样仍高度依赖西方对其产品的需求。在习上台之前的十年里，中国对欧盟、日本和美国的商品出口占总额的比例从50%下降到39%（见图表3）。但从那以后，这一比例没有再减少。中国希望和有些国家发展更密切的贸易关系，但这些国家实在太小，无法取代美国、欧洲和日本的巨大市场。很难做到一边生产更多高科技产品和服务，一边指望是穷国而不是富国的购买占比增加。尽管习和俄罗斯总统普京总是热情握手，但俄罗斯只购买了从中国出口总额的2%。

近年来，中国一直设法与一些它认为赞同自己目标的国家发展更紧密的金融联系。这包括尝试推动人民币国际化。这样做是为了减少中国对美元的依赖，从而不那么容易受到美国金融制裁的打击。为此中国已在慢慢向外国投资者开放其债券市场。2010年代初，中国人民银行开始与其他国家的央行签署以人民币计价的互换协议（即紧急信贷额度）。中国还一直努力发展数字人民币，这可以让使用人民币的交易提速也更易监控。今年，中国企业一直在用人民币支付从俄罗斯进口的大宗商品，这有助于减轻西方制裁对俄罗斯的影响，同时也提高了人民币的国际地位。

但中国与紧邻国家的金融联系仍然薄弱。以其债券市场为例。由四位经济学家——克里斯托弗·克莱顿（Christopher Clayton）、阿曼达·多斯桑托斯（Amanda Dos Santos）、马泰奥·马吉奥里（Matteo Maggiori）和杰西·施雷格（Jesse Schreger）——合著的新论文研究了私人投资者持有的人民币计价债券。近年来，用于购买这些资产的绝大多数资金来自美国、欧元区和日本。国际货币基金组织的卡米洛·托瓦尔（Camilo Tovar）和塔尼亚·莫德-诺（Tania Mohd-Nor）在2018年发表的一篇论文研究了人民币对其他货币的重要性（即一种货币对另一种货币的影响

力），结果发现“没有证据表明人民币是亚洲的主导货币，无论是通过影响亚洲地区的汇率还是通过亚洲的供应链”。

简而言之，中国让经济更加自给自足的努力本身并没有完全成功。更有甚者，试图打造这样的经济已经引发了一系列矛盾。例如，在海外推广使用人民币的愿望与让中国隔绝于全球金融波动的努力相冲突。由此产生的混乱局面使得中国既算不上全球金融的重要力量，又不能免受超出其可控范围的市场波动的影响。目前大多数月份里，在通过金融通讯网络SWIFT进行的跨境结算中，人民币所占份额都在2%左右，相比过去五年的大部分时间并无变化。即便这么看也夸大了人民币的影响力，因为中国大陆以外大部分涉及人民币的交易都是在香港进行的，香港是中国的一部分，但使用另一种货币。

在全球范围内，人民币是极少数其他货币的“锚定物”（见图表4）。人行签署的以人民币计价的新互换协议数量已经急剧下降。去年，国际货币基金组织的迈克尔·珀克斯（Michael Perks）、饶煜东、申钟顺（音译）和德冈喜一发表的研究报告发现，相比于美国，中国的银行系统在全球金融中发挥的作用仍然很小（见图表5）。中央财经大学的方意等人撰写的新论文认为，中国市场“受七国集团金融市场的影响更大，而不是反过来”。美国一打喷嚏，世界其他地方就会感冒。而如果中国打喷嚏，多数国家只消把唾沫星子掸一掸。

中国推动自立更生而导致的另一个矛盾与生产率有关。在习任内，全要素生产率（即每单位劳动力和资本的产出）几乎未见增长，相比金融危机之前明显减速（见图表6）。中国政府认为力争在高科技行业做到自给自足将会鼓励创新，从而提高生产率。事实上，结果更有可能是相反的。政府下力气支持本国领军企业，并激励与友好国家的贸易，到头来博得优势的公司可能并不是某个产品最高效或最有能耐的供应商，这就会削弱生产率。这样做前景堪忧，因为唯有提高生产率才是提升生活水平的持久途径。

习的两大夙愿——无论是让中国经济和技术能够抵御可能的打击，还是寻

找更可靠的贸易和投资伙伴——单独来看都是艰巨的任务。合起来看，它们已经引发了自相矛盾，很可能还会引发更多。就其本质而言，贸易和投资在创造互惠互利之时必然也使得互有风险。中国的领导人认为对西方技术、市场和金融系统的依赖让自己面临风险，这是对的；但如果他们以为自己可以摆脱这种困境，那就错了。不管习对中国的火箭专家说什么，要想不相互依赖，就只能接受穷困潦倒。■



Secret sauce

The recipe for the outperformance of Swiss businesses

Common sense and low taxes make the Alpine nation a corporate haven

Big cheeses from the world of politics, business, academia, media and the arts descended on Davos on May 22nd for the first in-person bash of the World Economic Forum in more than two years. For over half a century the great and the good have used the annual get-together to chew over the world's most pressing problems. They feel at home in Switzerland. Just as the small mountain village punches far above its weight as a talking-shop, Switzerland has prospered as a haven for businesses far beyond what might be expected of a small, landlocked country with few natural resources. It is home to 13 of the top 100 European firms by market capitalisation and 12 of the top 500 worldwide. What is the secret sauce of the Swiss?

Something remarkable must be going on in the nation of mountains and valleys that before playing host to world-beating firms counted the invention of yodelling among its achievements. Relative to its GDP Switzerland has the highest density of Fortune 500 companies in the world (see chart 1). Multinationals contribute around one-third of Switzerland's economic output, a much higher share than in other countries of comparable size. Foreign firms are drawn to Switzerland: Google set up its largest engineering centre outside America in Zurich. Swiss blue-chip firms outperform European rivals: the Swiss stockmarket index has risen by 29% over the past five years, compared with 3% for the Euro Stoxx 50, an index dominated by French and German behemoths.

Swiss firms' name recognition has spread far beyond the country's borders in banking (UBS and Credit Suisse), insurance (Swiss Re and Zurich), pharmaceuticals (Roche and Novartis), food (Nestlé), commodities trading (Glencore and Gunvor), watchmaking (Richemont, Patek Philippe and

Rolex), hotels (César Ritz was the youngest of 13 children of a Swiss farmer) and, inevitably, chocolate (Lindt & Sprüngli, and Barry Callebaut, the world's biggest chocolate-maker).

There are several explanations for Switzerland's corporate one-upmanship. One is that the country's defining characteristic is "common sense", says Paul Bulcke, chairman of Nestlé. This manifests itself in a unique political model that mixes federalism and direct democracy, a weak central government, light regulation, top-notch research universities, and rivalry in education and taxation between the cantons that make up the Swiss confederation.

For much of its history Switzerland was poor. Infertile soil, often covered in snow for most of the year, made the landscape inhospitable. So when Switzerland started to develop economically in the 19th century city-cantons such as Zurich or Basel began to specialise in high-value-added industries. St Gallen focused on textiles; Zurich on silk and spinning; Berne was the centre of the cheese trade; and Basel became a hub for budding pharmaceutical and chemicals industries. Watchmaking was mainly located in the Jura arc stretching from Geneva to Basel and the banking and insurance industries prospered in Geneva and Zurich.

This endeavour was assisted by Switzerland's "eternal neutrality", granted at the Congress of Vienna in 1815. It was spared two world wars that devastated the rest of Europe in the last century. At the same time it benefited from an influx of skilled folk fleeing strife elsewhere on the continent and from the cash they deposited in Swiss bank accounts. For James Breiding, author of "Swiss Made: The Untold Story Behind Switzerland's Success", the vital ingredient is an openness to the world that attracts international talent, including persecuted minorities such as France's Huguenots in the 17th century and Germany's Jews in the 1930s and 1940s.

Foreigners have been central to Switzerland's business success. Henri Nestlé, the eponymous founder of the company, hailed from Frankfurt. Antoni Norbert Patek, the pioneering watchmaker and creator of Patek Philippe, was a Polish cavalry officer. Leo Sternbach, a Polish Jew who fled the Nazis, invented Valium, which became Roche's blockbuster tranquilliser. Nicolas Hayek, the co-founder of Swatch, a popular watchmaker, was of Lebanese descent. About half of the CEOs of Switzerland's biggest firms are foreign. Severin Schwan of Roche is Austrian, Gary Nagle of Glencore is South African and Vasant Narasimhan of Novartis is Indian-American.

Switzerland's welcoming of outsiders stands in stark contrast to relations within. The Swiss have no particular affinity for their compatriots in other cantons. The country's city-states would doubtless have preferred to remain independent, only becoming a bigger unified entity to defend themselves against rapacious neighbours. But they joined together in such a way as to foster self-reliance and responsibility. "Like peasants buying cabbage at the market the city-states shopped around for the cheapest social contract they could find and ceded as little personal freedom for the greatest gain," says Mr Breiding.

This approach makes for light regulation from the top. The Federal Council, the federal government's executive branch, does without recognisable leaders. The cabinet has seven members who have equal power. Each of them spends a year as president, ensuring that no one remembers their names for long. While the council has few powers, the country's 26 cantons have plenty, as do its more than 2,000 municipalities.

Cantons run health care, welfare, education, law enforcement and fiscal policy. That allows them to compete to be attractive to businesses and their workers. Corporate taxes are low (see chart 2). Lucerne halved its rate in 2012. Zug has the lowest corporate tax rate at 11.9%. Only "offshore"

financial centres such as Guernsey and Qatar have lower tax rates than those levied in the low-tax cantons, states a report by KPMG, an accounting firm. Compare that with France where the rate is 26.5%.

The competition doesn't stop at light taxation. Cantons help to fund top-notch universities. Zurich's Eidgenössische Technische Hochschule (ETH), one of the two federal institutes of technology, is regularly ranked among the best universities in continental Europe. Strong links between business and academia mean that graduates have the right skills. For instance, in January 2020 Nestlé, the Ecole Polytechnique Fédérale de Lausanne (EPFL), the other federal institute of technology, the canton of Vaud and the Swiss Hospitality Management School in Lausanne launched the "Swiss Food Nutrition Valley", a research programme to promote innovation in sustainable food production. Logitech, a maker of software, and Cisco, a technology firm, have research centres on the EPFL campus.

Yet for all its success Switzerland has become less attractive as a hub for multinationals over the past three decades. In 1990 two-thirds of America's top 20 companies (including General Motors, Hewlett-Packard and IBM) had their European headquarters in Switzerland. In 1992 Swiss voters decided against following the Norwegian example and joining the European Economic Area with access to the EU's single market. As a result some of the world's most successful firms, such as Apple, Alibaba and Samsung, set up in Amsterdam, Dublin or other EU business hubs. Last year Switzerland missed another chance to gain smooth access to one of the world's largest markets when its government abandoned plans to convert 120 bilateral deals into an overarching treaty with the EU.

And much that accounts for Switzerland's corporate strength is in question. The war in Ukraine makes some Swiss ponder the country's neutral status; to widespread surprise, their government has joined Western sanctions against Russia. In the past, any tinkering with neutrality was considered a

betrayal of the nation, says André Hoffmann, vice-chairman of Roche. Moreover, the country is still dealing with the rehabilitation of its wealth-management industry, which has been forced to clean up its act over the past 15 years after America declared war on Swiss banks that had helped its citizens dodge billions of dollars in tax. According to Mr Breiding, wealth management remains under threat from lower investment returns and increasing international pressure for financial transparency. The pharmaceutical sector is grappling with the rapid rise in costs for drug innovation.

Yet the Swiss have shown in the past that they can overcome challenges with hard work and ingenuity. Swiss watchmaking seemed to be winding down the path to extinction until Swatch revived the industry by making cheap watches more fun and expensive ones more desirable. Chances are that the great and good of Davos will feel right at home in Switzerland for many years to come. ■



秘制酱汁

瑞士企业表现卓越的秘方

讲常识和低税收让这个阿尔卑斯山区国家成为企业天堂

来自政界、商界、学界、媒体和艺术界的大咖在5月22日齐聚达沃斯，参加世界经济论坛两年多来的首次线下盛会。半个多世纪以来，各界大人物一直通过这个年度盛会来探讨全球最紧迫的问题。瑞士让他们感觉宾至如归。达沃斯这个山村虽小，作为论坛举办地却影响力巨大；同样，瑞士虽然只是自然资源匮乏的内陆小国，却发展成了企业的避风港，获得的成功远超人们的预期。瑞士拥有13家欧洲市值100强公司和12家全球500强公司。瑞士人用了什么秘方？

这个山高谷深的国家一定是做了什么非凡之举，毕竟在拥有这么多世界一流公司之前，连发明约德尔唱法都算得上是它的一项成就。按GDP规模折算，瑞士的财富500强公司密度为全球最高（见图表1）。跨国公司贡献了瑞士约三分之一的经济产出，这一比例远高于其他同等规模的国家。外国公司深受瑞士吸引，谷歌在苏黎世设立了美国以外最大的工程中心。瑞士蓝筹股公司的表现优于欧洲的竞争对手，瑞士股指在过去五年中上涨了29%，而法国和德国大型公司占据主导的欧洲斯托克50指数（Euro Stoxx 50）只上涨了3%。

瑞士的公司声名远播，包括银行（瑞银和瑞信）、保险（瑞士再保险和苏黎世保险）、制药（罗氏和诺华）、食品（雀巢）、大宗商品贸易（嘉能可和贡沃尔[Gunvor]）、制表（历峰[Richemont]、百达翡丽和劳力士）、酒店（凯撒·丽兹[César Ritz]是一个瑞士农夫13个孩子中的老幺），当然还有巧克力（瑞士莲和世界上最大的巧克力制造商百乐嘉利宝[Barry Callebaut]）。

瑞士公司胜人一筹有几种解释。首先，该国的根本特征是“常识”，雀巢董事长保罗·布尔克（Paul Bulcke）说。这体现在瑞士独特的政治模式上，它融合了联邦制和直接民主、小政府、轻监管、一流的研究型大学，以及

组成瑞士联邦的各州在教育 and 税收方面的竞争。

瑞士在历史上大部分时间里都很贫穷。土地贫瘠，一年中的多数时间都被冰雪覆盖，一片荒凉。因此，当瑞士经济在19世纪开始发展时，苏黎世或巴塞尔等城市和州开始重点发展高附加值产业。圣加仑（St Gallen）专注纺织品，苏黎世专攻丝绸和纺纱，伯尔尼是奶酪贸易中心，巴塞尔成为新兴制药和化学工业的中心。制表业主要分布在从日内瓦到巴塞尔呈弧形延伸的侏罗（Jura）山谷。银行和保险业在日内瓦和苏黎世蓬勃发展。

1815年的维也纳会议赋予了瑞士“永久中立”的地位，推动了瑞士高附加值产业的发展。上个世纪的两次世界大战让欧洲其他地区伤痕累累，而瑞士都幸免于难。与此同时，大量技术工人为逃避欧洲大陆其他地方的战乱冲突涌入瑞士，并将携带的现金存入了瑞士的银行，让该国受益匪浅。在《创新的国度：瑞士制造的成功基因》（Swiss Made: The Untold Story Behind Switzerland's Success）一书的作者詹姆斯·布雷丁（James Breiding）看来，瑞士配方的核心成分是对世界的开放，这吸引了各国人才，包括受迫害的少数群体，如17世纪法国的胡格诺派人士和上世纪三四十年代德国的犹太人。

外国人对瑞士的商业成功一直至关重要。雀巢公司的创始人亨利·雀巢（Henri Nestlé）来自法兰克福。制表先驱和百达翡丽的创始人安东尼·诺伯特·百达（Antoni Norbert Patek）曾是一名波兰骑兵军官。逃避纳粹迫害的波兰犹太人里奥·斯特恩巴赫（Leo Sternbach）发明了安定片（Valium），成为罗氏的重磅镇静药物。著名制表商斯沃琪的联合创始人尼古拉斯·海耶克（Nicolas Hayek）是黎巴嫩裔。瑞士最大公司的CEO中约有一半是外国人。罗氏的塞弗林·施万（Severin Schwan）是奥地利人，嘉能可的加里·纳格（Gary Nagle）是南非人，诺华的万思瀚（Vasant Narasimhan）是印度裔美国人。

瑞士对外国人的欢迎和它内部国人间的关系形成了鲜明对比。瑞士人对其他州的同胞没有特别的亲近感。各州当初无疑更愿意保持独立，只是为了抵御贪婪邻国的侵害才结合成为一个更大的统一实体。但是它们的结合方

式促进了自力更生和责任感。“就像农民在市场上买卷心菜一样，各州四处寻找成本最低的社会契约，让渡最少的个人自由换取最大的利益。”布雷丁说。

这种方式造就了政府的宽松监管。联邦政府的行政部门联邦委员会（Federal Council）没有知名领导人。委员会有七名成员，权力相等，每人轮流担任总统一年，这使得他们的名字没有人会记住很久。委员会虽然没什么权力，但瑞士的26个州却拥有很大的权力，它的2000多个市镇也是如此。

各州实施各自的医疗、福利、教育、执法和财政政策。这让它们能够互相竞争以吸引企业及其员工。各地的企业税都很低（见图表2）。卢塞恩州（Lucerne）在2012年将税率减半。楚格州（Zug）的企业税率最低，只有11.9%。会计师事务所毕马威的一份报告称，只有根西岛（Guernsey）和卡塔尔等“离岸”金融中心的税率低于瑞士的低税率州。相比之下，法国的税率为26.5%。

竞争不止于轻赋税。各州都出力资助一流大学。瑞士两所联邦理工学院之一的苏黎世联邦理工学院（ETH）常年位居欧洲大陆顶级学府之列。商界和学术界联系紧密，让毕业生能学到业界所需的技能。例如，2020年1月，雀巢、另一家联邦理工学院洛桑联邦理工学院（EPFL）、沃州（Vaud），以及洛桑的瑞士酒店管理学院（Swiss Hospitality Management School）启动了“瑞士食品与营养研究谷”（Swiss Food Nutrition Valley）计划，旨在促进可持续食品生产的创新。软件制造商罗技和科技公司思科在EPFL的校区设有研发中心。

尽管瑞士取得了巨大的成功，但在过去30年里，瑞士作为跨国公司枢纽的吸引力却有所减弱。1990年，美国前20大公司中有三分之二（包括通用汽车、惠普和IBM）将欧洲总部设在瑞士。1992年，瑞士公民投票决定不跟随挪威加入可进入欧盟单一市场的欧洲经济区（European Economic Area）。因此，苹果、阿里巴巴和三星等全球最成功的公司把欧洲总部设在了阿姆斯特丹、都柏林或其他欧盟商业中心。去年，瑞士政府放弃了将

120项双边协议合并成一个与欧盟的整体框架协议的计划，又错失了一个顺利进入全球最大市场之一的机会。

而很多构成瑞士商业优势的因素现在都有不确定性。俄乌战争让一些瑞士人思索本国的中立地位：令人普遍感到惊讶的是，他们的政府已加入西方对俄罗斯的制裁。罗氏副董事长安德烈·霍夫曼（André Hoffmann）表示，在过去，任何稍稍改动中立地位的行为都被认为是对国家的背叛。此外，瑞士仍在努力重振其财富管理行业，在过去15年里，美国向帮助其公民巨额逃税的瑞士银行发起了法律挑战，该行业被迫开展整顿。布雷丁表示，财富管理仍然受制于投资回报下降以及国际上要求金融透明度的压力日增。制药行业正在艰难应对药物创新成本的快速上升。

不过，瑞士人过去的经历已经向世人展示，他们能凭借兢兢业业和心灵手巧克服挑战。瑞士制表业一度似乎要走向灭亡，但后来斯沃琪把廉价手表做得更有趣，让昂贵的手表更令人向往，制表业又重振雄风。未来很多年里，达沃斯的大人物在瑞士很可能仍会感到宾至如归。■



The Economist Film

Building with wood: A concrete solution? (Part 2)

As the search for sustainability grows, so does the revival of interest in the potential of this age-old material.



经济学人视频

绿色建材（下）：木质摩天楼

随着人类对可持续建筑的追求不断升级，最古老的建材也引发了更多兴趣。



Free exchange

How to unleash more investment in intangible assets

A new book urges financial and economic reforms

When Russia invaded Ukraine, tangible things at first seemed all too important. Bombs and bullets were what mattered; commodity markets were roiled; supply chains were upturned. As the war has gone on, however, intangible factors have asserted their importance, too. The managerial and logistical know-how of the armed forces on either side, as well as technological advantages, like Ukraine's deployment of Bayraktar drones, have altered the course of the war. So too has the goodwill that Ukraine has attracted from people around the world, which has in turn led foreign governments to lend the country more support.

The idea that intangible assets, though hard to see and measure, are critically important to foster, is the main message of a new book by Jonathan Haskel, a Bank of England policymaker, and Stian Westlake of Britain's Royal Statistical Society. "Restarting the Future" is their second book. The first, "Capitalism Without Capital", published in 2017, argued that the economics of intangible assets helped explain stagnating economic growth and rising inequality. The new book goes a step further, asking how the bottlenecks holding investment in intangibles back might be loosened—thereby fostering a more efficient and faster-growing economy. Their work is part of a wave of writing on the future pace of growth, which includes Dietrich Vollrath's "Fully Grown" and Robert Gordon's "The Rise and Fall of American Growth".

Intangible investment includes the research and development conducted by firms, as well as things like marketing, design and branding. In the late 1990s, by some measures, spending on intangibles in America overtook investment in tangible plant and equipment. But the pace of spending has

slowed since the financial crisis. The authors note that annual growth in intangible capital in rich countries tended to be around 3-7% between 1995 and 2008. Over the subsequent decade, however, it barely surpassed 3% in any single year. That did not just reflect slower economic growth.

Intangible investment also stopped rising as a share of GDP, which poses something of a conundrum, considering that corporate profits were strong. Although the burst of overall investment in the past year or so has been impressive, cross-country data on intangibles are not yet available. Nor is it clear that the investment surge has done enough to alter the sluggish trend.

The nub of the problem, say Messrs Haskel and Westlake, is that the economic and financial arrangements that exist to support investment are geared towards spending on capital goods, not intangibles. They point out that bursts of economic growth, such as those in medieval Italian city states and in China between the 10th and 13th centuries, have often faded precisely because institutions failed to generate the right incentives and activity.

Part of the solution this time, say the authors, is to encourage the financing of investment in intangibles. A study by the OECD, which looks at 29 developed economies from 1995 to 2015, suggests that intangible-heavy sectors are more productive in places with more developed financial systems, where they can access finance more easily. Differences in financial development, as measured by a combination of equity-market capitalisation and total credit to GDP, can explain why annual labour-productivity growth in a sector like computer equipment (where two-thirds of assets are intangible) has been a percentage point higher in more financially developed countries like Japan than in places like Portugal.

Venture capital (VC) has been a preferred source of equity funding for firms conducting the most intangible activity, such as biotechnology and consumer-tech. But that has been disproportionately available to American

companies with a plan for extremely rapid growth. In many parts of the world, a lot of business investment is still debt-financed, and more dependent on the use of physical assets as collateral.

America's VC industry took off after pension funds were allowed to invest in less liquid investments in 1979. That may help explain why business investment in America has held up better than in many other places. The authors therefore advocate for larger investment vehicles that pool risk for individual lenders elsewhere in the world, like the Long-Term Asset Fund launched in Britain last year, which helps pension funds gain exposure to long-term illiquid assets. Ending the tax advantages of debt financing by removing the tax deductibility of interest payments, say, would help level the playing-field between tangible and intangible investment.

Other prescriptions relate to how and where investment occurs. Patent law, for instance, should not prevent the combination of existing ideas. More important still is the role of cities, which, the authors note, are cauldrons of intangible investment: they make it easier to form the relationships that make intangibles happen, encourage new ideas and create a larger pool of beneficiaries when investments spill over. Making cities work, therefore, with better land-use and zoning policies, is vital.

| *Can't touch this*

"Restarting the Future" may be emblematic of a shift in economists' thinking on growth. In the 2010s debates raged over how best to address persistent shortfalls in demand. In the inflationary-looking 2020s, the emphasis is on unleashing the economy's supply potential. But where researchers such as Mr Gordon and Mr Vollrath regarded the bursts of rapid growth in the 20th century as the exception, not the rule, Messrs Haskel and Westlake are more hopeful of a return to headier rates of growth.

Mr Gordon argued that the digital economy was a busted flush when it

came to growth; Mr Vollrath saw slower growth as a symptom of economic success, a larger services sector and reduced geographic mobility. By presenting solutions, “Restarting the Future” offers a more optimistic vision—as long, that is, as governments follow its advice.

Read more from Free Exchange, our column on economics: The world needs a new economic motor. Could India fit the bill? (May 14th) Why long-term economic growth often disappoints (May 7th) How would an energy embargo affect Germany’s economy? (Apr 30th)

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自由交流

如何释放更多无形资产投资

一本新书敦促施行金融和经济改革

当俄罗斯入侵乌克兰时，有形的事物在一开始看起来非常重要。炸弹和子弹左右局面，大宗商品市场动荡不安，供应链乱作一团。然而，随着战争的继续，无形的因素也展示出自己的重要性。双方军队的管理和后勤能力及技术优势（例如乌克兰部署的Bayraktar无人机）改变了战争进程。乌克兰从世界各地人民那里吸引到的善意也有这样的效果——它让外国政府向该国提供了更多支持。

无形资产虽然不容易看到和测量，但培育无形资产却至关重要，这是英国央行官员乔纳森·哈斯克尔（Jonathan Haskel）和英国皇家统计学会（Royal Statistical Society）的斯蒂恩·韦斯特莱克（Stian Westlake）合著的新书传达的主要信息。《重启未来》（Restarting the Future）是他们的第二本书。出版于2017年的第一本《没有资本的资本主义》（Capitalism Without Capital）认为无形资产经济学有助于解释为什么会出现经济增长停滞和不平等加剧。这本新书更进一步，探讨如何才能打开阻碍无形资产投资的瓶颈，从而培育出更高效、更快速增长的经济。近年有一系列关于未来增长速度的著作问世，他们的这本新书就是其中之一，其他还包括迪特里希·沃尔拉斯（Dietrich Vollrath）的《完全成熟》（Fully Grown）和罗伯特·戈登（Robert Gordon）的《美国增长的兴衰》（The Rise and Fall of American Growth）。

无形投资包括公司的研发，以及营销、设计和品牌推广等。在上世纪90年代后期，按照某些衡量标准，美国在无形资产上的支出超过了对厂房和设备等有形资产的投资。但自金融危机以来，这部分支出的速度已经放缓。作者指出，从1995年到2008年，富裕国家无形资本的年增长率一般在3%到7%左右。然而在随后十年中，每年都只是增长3%略多。这反映出的不仅是经济增长放缓。无形投资占GDP的比重也停止了上升，鉴于企业利润增长强劲，这让人百思不得其解。尽管过去大约一年里整体投资的爆发式

增长令人印象深刻，但目前还没有关于无形资产的跨国数据。也不清楚投资激增是否足以改变这一低迷趋势。

哈斯科尔和韦斯特莱克认为，问题的关键是现在用以支持投资的经济和金融制度针对的是对资本品的支出，而不是无形资产的支出。他们指出，爆发式经济增长（比如中世纪的意大利城邦和10世纪至13世纪的中国所经历的那种）之所以会消退，往往就是因为制度没能产生正确的激励和活动。

作者说，这一次，解决方案的一部分是鼓励无形资产投资的融资。经合组织研究了29个发达经济体在1995年到2015年间的情况，结果显示在金融体系更发达、更容易获得融资的地方，无形资产密集型部门的生产率更高。股票市值和信贷总额占GDP比例可以衡量金融发展程度的差异，这种差异可以解释为什么在计算机设备（其中三分之二的资产是无形的）这样的行业，劳动生产率的年增长在日本等金融较发达的国家要比葡萄牙等国要高出一个百分点。

对于无形程度最高的生物科技和消费科技等公司而言，风投一直是它们首选的股权融资来源。但是在获得了这种投资的公司中，有极速增长计划的美国公司多得不成比例。在世界上许多地方，很多商业投资仍然来自债务融资，并且更多依赖于使用实物资产作抵押。

美国风投行业的腾飞始于1979年养老基金获准参与流动性较低的投资。这可能有助于解释为什么美国的商业投资一直强于其他许多地方。因此，作者主张采用规模更大的投资工具，为世界其他地方的单个贷款机构分担风险，去年在英国推出的长期资产基金（Long-Term Asset Fund）就是一个例子，该基金帮助养老基金投资长期非流动性资产。结束债务融资的税收优势，比如取消利息抵税，将有助于让有形和无形资产投资更公平地竞争。

书中其他建议与投资的方式和地点有关。例如，专利法不应阻止组合已有的创意。城市的作用就更重要了。作者指出，城市是无形投资的大熔炉——在城市更容易形成能创造无形资产的关系，也更容易鼓励新想法，并

在投资溢出时产生更多的受益者。因此，通过更好的土地利用和分区政策让城市发挥作用至关重要。

| 这个不能碰

《重启未来》可能代表着经济学家对增长思考发生了转变。在2010年代，引发激烈争论的是如何最好地解决需求持续不足的问题。在看起来会由通胀主导的2020年代，关注的重点是释放经济的供给潜力。戈登和沃尔拉斯等研究人员认为20世纪的几次爆发式增长是例外而非非常规，但哈斯克尔和韦斯特莱克对再现那种高速增长更为乐观。

戈登认为，数字经济在增长方面的表现虎头蛇尾。沃尔拉斯认为增长放缓是经济成功、服务业规模扩大和地域流动性降低的征候。通过提出解决方案，《重启未来》给出了一个更加乐观的愿景，不过这待看政府是否会听从它的建议。





Bartleby

Making brainstorming better

Let's pour some thought bubbles into the ideas jacuzzi

The word “brainstorming” conjures up a vision of hell. It is someone saying, “Fire up the brainwaves barbecue.” It is trying desperately to work out where everyone else’s cursors have gone on a digital whiteboard. It is hearing the line “there are no bad ideas” and thinking “how did this get scheduled then?”

Yet brainstorming persists, and for decent reasons. Normal routines afford employees precious little time to think. Getting a group of people together is an opportunity to harness disparate viewpoints. Producing, filtering and selecting new ideas in an efficient way is an appealing proposition. So why is brainstorming often so painful?

The problem is that brainstorming must strike a balance between a series of competing imperatives. One tension is between creativity and feasibility. A brainstorm is meant to be freeing, a chance to ask out-of-the-box questions (like, “Wouldn’t it be great if people had prosthetic tails?”). But it is also meant to produce suggestions that can actually be translated into reality, which calls for a more pragmatic style of thinking (like, “What are you talking about? We work at a salad chain.”).

Research carried out in 2017 found that different types of ideas emerge at different stages of a brainstorm. The most feasible suggestions were generated at the start of brainstorming sessions, presumably because they were also more obvious, and the most original ones came later. Both types risk producing a “what’s the point?” reaction from participants: incrementalism is unexciting, wild schemes are not going anywhere.

A second tension is between managers and non-managers. By its nature brainstorming is insiderish. Someone has to arrange the session, and that person is often the manager of a team. If decision-makers are not in the room, then the suspicion will grow that time is being wasted. If they are, then hierarchies easily assert themselves: good ideas can wither with a frown from the boss, and bad ones can survive with a nod.

A related issue concerns the presence of outsiders. There is a natural temptation to keep drawing on the same senior people within an organisation to generate ideas: these are the ones who get things done, who understand a company's strategy.

Yet reams of research suggest that outsiders bring a fresh perspective. That might be people from related industries: in an experiment carried out in 2013, carpenters, roofers and rollerbladers were asked how to improve safety gear in all of their fields and the most novel ideas came from people who were not in the area in question. But it might also be middle managers or front-line employees who have direct contact with customers.

A third balance to strike is between different personalities and different styles of thinking. A new paper from researchers at Columbia Business School and Stanford Graduate School of Business finds that brainstorming on Zoom comes at a cost to creativity: as people's visual focus narrows on the screen in front of them, their cognitive range also seems to become more limited. But if in-person gatherings are better, they also do not work equally well for everyone. Some personalities are immediately comfortable saying what they think; others need to be coaxed to share their opinions.

These are known problems, and there are plenty of ideas out there to solve them. The trouble is that lots of them feel like they are themselves the product of a bad brainstorming session. "Figure-storming" is a way for people to combat groupthink by pretending to be a famous person ("how

would the queen improve cloud computing?”). “Step-laddering” involves people joining a brainstorm one by one, for reasons that are not entirely clear. Breaking the ice by throwing a word-association ball at each other is a brilliant idea, if you are throwing a birthday party for ten-year-olds.

Some simpler rules are much more likely to help. Define the parameters of a brainstorming session upfront. Try to make a specific thing work better rather than to shoot for the Moon. Involve people you don’t know, as well as those you do. Start by getting people to write their ideas down in silence, so extroverts and bosses have less chance to dominate. And be clear about the next steps after the session is over; the attraction of holding a “design sprint”, a week-long, clear-the-diary way for a team to develop and test product prototypes, is that the thread connecting ideas to outcomes is taut. All of which would make brainstorming a little more thought-provoking and a tad less heart-sinking. ■



巴托比

烧脑有道

给创意大杂烩加点思想佐料

听到“头脑风暴”这个词会让人如坠地狱。可能是有人在说“开启疯狂烧脑模式”。也可能是拼命想跟上其他人在电子白板上乱窜的光标。还可能是听到一句“没有什么想法是糟糕的”，心想“那这个会又是怎么安排上的？”

然而头脑风暴仍然存在，而且有很好的理由。日常按部就班的工作留给员工思考的时间很少。把一群人聚在一起有机会发掘利用大家各自不同的观点。高效地产生和筛选新想法听起来是件很有吸引力的事。那么，为何头脑风暴常常让人如此痛苦？

问题在于，头脑风暴必须在一系列相互矛盾的要务之间取得平衡。第一个矛盾存在于创意和可行性之间。头脑风暴是为了解放思想，允许提出超越常规的问题（例如，“如果给人们装上假尾巴，岂不是很棒？”）但它也要提出能真正实行的建议，这就需要一种更加务实的思维方式（例如，“你在说什么呀？我们这可是一家沙拉连锁店。”）

2017年的研究发现，在头脑风暴的不同阶段会涌现不同类型的想法。最可行的建议一般出现在头脑风暴刚开始的时候，也许是因为它们比较容易想到，而最具原创性的想法在后头才会冒出。这两种类型的想法都可能让参与者质疑“这有啥意义？”，毕竟渐进主义枯燥乏味，而荒诞不经的方案让人讨论不出个所以然。

第二个矛盾存在于管理者和非管理者之间。头脑风暴本质上是一种内部活动。会议得有人来安排，而这个人往往是团队的管理者。如果决策者不在场，那么大家就会怀疑这是在浪费时间。如果决策者在场，那么层级的影响很容易就显现出来：老板一皱眉，再好的想法也会无疾而终；老板一点头，再糟糕的想法也能保留下来。

一个相关问题是局外人的参与。人们会自然而然地依赖组织内的同一批资深人士来提供灵感：这些人了解公司的战略，能把事情搞定。

然而，大量研究表明，局外人可以带来全新的视角。他们可以是来自关联行业的人士：2013年的一项实验询问了木工、屋顶修理工和轮滑手如何改进全部三个领域中的安全装备，结果最新颖的想法都来自非本行业的人。但新想法也可以来自中层管理人员或直接面对客户的一线员工。

第三个矛盾是要在不同性格和不同思维方式之间取得平衡。哥伦比亚大学商学院和斯坦福大学商学院的研究人员最近发表的论文发现，在Zoom上头脑风暴会折损创造力：当人们的视觉焦点局限在眼前的屏幕时，他们的认知范围似乎也收窄了。但是，如果说面对面的会议效果更好，那也并非对每个人都一样好。有些性格的人能够随时自如地说出自己的想法，而有些人要在循循诱导之下才能分享观点。

这些都是已知的问题，已经提出的解决方案也很多。麻烦的是，许多办法本身就像是一场糟糕头脑风暴的产物。“人物风暴”（Figure-storming）通过假扮名人来打破群体思维（“女王会如何改进云计算？”）。“阶梯法”（Step-laddering）让参与者一个接一个地加入头脑风暴，但这样有什么好处并不是很清楚。如果你是在给十岁孩子办生日派对，那么玩字词联想游戏来破冰倒真是个好主意。

一些简单点的规则可能要有用得多。事先确定头脑风暴会议的讨论范围。尝试去改进一件具体的工作，而不是幻想一步登天。除了你认识的人以外，也要让一些不认识的人参与进来。一开始的时候，让大家默默写下自己的想法，这样性格外向的人和老板就不太容易支配全局。会议结束后要明确接下来的行动；“设计冲刺”（团队腾出一周时间，取消所有其他安排，专心开发和测试产品原型）之所以有吸引力，就是因为它将想法和结果紧凑地串联起来。所有这些方法都会让头脑风暴给人多一点点启迪，少一点点心累。 ■



Pillar talk

China plans to roll out private, personal pensions

About time

“ASTONISHING”, “SPECTACULAR”, “unprecedented”: China has won plaudits from the World Bank and other experts for the rapid expansion of its basic state pensions over the past dozen years. The number enrolled in these schemes (including one for urban employees) crossed 1bn in 2021. But the speedy construction of this first “pillar” of China’s pension system has not been matched elsewhere in the planned edifice.

A second pillar is supposed to rest on firms, which can enroll employees in a company pension. But fewer than 29m people, less than 10% of the eligible workforce, had signed up for these “enterprise annuities” by the end of last year. China’s third pillar—personal pensions—is even stumpier. Although individuals in China save a lot, buying homes and other assets, they have little reason (or inclination) to set up personal pensions. To give them a nudge, China’s government launched pilot schemes in Shanghai, Fujian and part of Suzhou back in 2018. These schemes offered modest tax breaks to people willing to lock up their money in pension products offered by approved financial institutions. But take-up was disappointing and the third pillar has made little progress since.

The delay is a pity, because China is not getting any younger. By the end of this decade, it will have more people aged 60 or above than America will have people. Many of these old folk face a precarious retirement, balanced only on the first pillar. And time is also running out for China’s younger cohorts. Well-designed pension products work best when people start contributing in their 20s, allowing them to make high-risk, high-return investments they should avoid later in life. But China’s population of 20-somethings peaked in the 1990s and has shrunk by almost 50m in the

past ten years.

The urgency is not entirely lost on China's leaders. On April 21st the State Council, China's cabinet, released a set of guidelines on private personal pensions, instructing ministries to launch more pilot projects, then roll out schemes nationwide. "There is not much meat on it," says Nicholas Omondi of Z-Ben, a financial consultancy in Shanghai. But the announcement nonetheless sends a "strong message" to China's rivalrous regulators "to get their act together and get this done".

If personal pensions do take off, they could have salutary effects on China's investment habits and financial markets. At the moment, city-dwellers keep two-thirds of their wealth in housing, according to a survey in 2019 by Southwestern University of Finance and Economics. Too much of the rest is either in barren cash or "rolling from one end of the stockmarket to another", as Mr Omondi puts it, "without much of a fundamental anchor". In China "saving is not a problem", says Yothin Jinjarak of the Asian Development Bank. "But where the savings go, that's the question."

Well-run pension funds, with a longer-term horizon, could contribute to a better allocation of capital in China. That, in turn, would make future workers more productive—which they will need to be if they are to take care of themselves, their children and their elderly parents comfortably.

But even if China's authorities speedily approve these better financial mousetraps, will customers beat a path to them? The tax breaks on offer are not wildly tempting. People can deduct contributions of up to 12,000 yuan (\$1,800) a year from their taxable income, according to the guidelines. That is about a quarter of average disposable income in urban China. But it is only 15% in a place like Shanghai. That will seem meagre to the city's higher earners. And if funds keep a tight lid on risk, as they should in a contributor's later years, returns may not look enticing to Chinese

investors, says Janet Li of Mercer, a consultancy, given that people dislike locking up their money for decades.

Thus, before Chinese households will invest enthusiastically in the third pillar, the government and industry will have to invest in educating them. As an example of what is required, Ms Li cites the animated videos prepared by the Insurance Asset Management Association of China. In one, a man sits behind a desk imagining all of his expenses—mortgage, children, car—and other burdens, such as elderly care. Even thinking about it turns his hair grey. The message is clear: if you fail to prepare for it, ageing will age you. ■



浅谈支柱

中国计划推广个人养老金

是时候了

“惊人”、“了不起”、“前所未见”……过去十几年来，中国基本养老保险的快速覆盖赢得了世界银行和其他专家的喝彩。2021年，参加这些养老金计划（包括一项针对城市职工的计划）的人数已超过10亿。但是，虽然中国养老金体系的这根第一“支柱”建造得飞快，它整栋大厦中的其他结构却没能及时跟上。

第二支柱本应建于企业之上，它们可以把员工纳入公司自主的养老保险。但到去年年底，只有不到2900万人参与了“企业年金”，还不到符合条件的劳动者的一成。个人养老金这第三根支柱就更是低矮了。尽管中国的个人会存很多钱来买房子和其他资产，但他们没什么理由（或意愿）设立个人养老金。为了稍微推他们一把，中国政府于2018年在上海、福建和苏州部分地区启动了试点计划。愿意将资金锁定在经批准的金融机构提供的养老金产品中的人将获得小额税收减免。但它们的接受度令人失望，此后第三支柱进展甚微。

这种迟缓令人遗憾，因为中国将不再年轻。到本个十年的尾声，中国60岁以上人口将比美国届时的总人口还多。这些老人当中有许多面临朝不保夕的退休生活，只能依靠第一支柱勉强度日。留给更年轻些的中国人的时间也不多了。精心设计的养老金产品需要人们从20多岁就开始缴款才能达到最佳效果，在那个年龄段他们能进行高风险、高回报的投资，而等到年岁渐长就该避免这种操作了。但是，中国20多岁的人口数量在20世纪90年代达到顶峰，过去十年里已减少了近5000万。

中国领导人并非全然不明白这个问题的紧迫性。4月21日，国务院发布了一系列关于个人养老金的指导方针，指示各部启动更多试点项目，然后在全国范围内推广。上海的商务咨询公司哲奔的尼古拉斯·奥蒙蒂（Nicholas Omondi）表示，“这里面没多少实质性的东西。”但这份声明

还是向中国各行其是的监管机构发出了一个“强烈信号”，要求它们“携手行动，把这事办成”。

如果个人养老金真的能成功推广开来，可能会对中国的投资习惯和金融市场产生有益的影响。根据西南财经大学在2019年的一项调查，目前，住房占到城市居民财富的三分之二。其余的部分有太多要么是没什么收益的现金，要么像奥蒙蒂所说的那样，“从股市的一端滚到另一端，没有什么基本的锚点”。在中国，“储蓄不是问题，”亚洲发展银行的尤林·金加拉克（Yothin Jinjarak）说，“但储蓄去了哪里，这是个问题。”

运营良好的养老基金所展开的长线投资可能改善中国的资本配置。这进而又会提高未来劳动者的生产率——如果他们想不太费力地照顾好自己、子女和年迈的父母，就需要提高生产效率。

但是，就算中国当局迅速批准了这些更好的金融策略，消费者会热烈追捧它们吗？它们所提供的税收减免并不十分诱人。根据指导意见，人们每年最多可以从应税收入中扣除12,000元的养老金缴费。这大约是中国城市平均可支配收入的四分之一，但在上海这样的地方只相当于15%。对该市的高收入者来说，这似乎微不足道。而如果养老基金严格控制风险（在参保者晚年也确实应该这么做），对中国投资者来说其回报可能就没什么吸引力了，因为人们不喜欢把钱封存几十年，咨询公司美世（Mercer）的李子恩说。

因此，在中国家庭热情高涨地投资于第三支柱这一天到来前，政府和行业得先投资于教育他们。李子恩拿中国保险资产管理协会制作的动画视频举例，来说明需要做些什么样的教育。在其中一条视频中，一个男人坐在桌子后面，想象他所有的开销——按揭贷款、孩子、汽车——以及其他重担，比如照顾老人。光是想一想他的头发就变白了。这传递出的信息很明确：如果你不做好准备，变老会让你苍老。■



Reframed work

America's new Asian economic pact: just don't call it a trade deal

And China is not invited

A mere three days after being sworn in as president in January 2017, Donald Trump signed an executive order withdrawing America from the Trans-Pacific Partnership (TPP), a 12-country free-trade deal he had railed against on the campaign trail. On May 23rd, 488 days after his own swearing-in, President Joe Biden tried to reverse some of the damage by unveiling a new pact, the 13-country Indo-Pacific Economic Framework (IPEF). That Mr Biden took so much longer to launch his Asian trade policy illustrates one basic truth: it is far easier to tear up agreements than it is to craft them anew.

Inevitably, one way to look at the IPEF is by way of comparison to the TPP (which lives on in reduced form, absent America). Some bits sound rather familiar. One selling-point for the TPP was that it was a “21st-century trade agreement” complete with high standards for workers’ rights and e-commerce rules. The IPEF is also “a 21st-century economic arrangement”, according to Jake Sullivan, America’s national security adviser. The original TPP members accounted for nearly 40% of global GDP, roughly the same share as the current IPEF partners. Most crucially, China is still excluded. The IPEF, like the TPP, is an attempt to build a trading structure in Asia that enshrines both America’s economic principles and its economic power—welcomed by many in the region as a counterbalance to China’s heft.

That, however, is where the similarities end. Mr Trump’s success in winning support with his calls to stop countries “ripping off” America has made many in Washington leery of ambitious free-trade deals. So rather than starting work on a pact that would require approval from Congress, Mr

Biden's team has designed a framework that is more malleable and may avoid that political death-trap. In announcing the launch, Katherine Tai, the United States Trade Representative (USTR), pledged to "keep Congress close" in shaping the IPEF—a far cry from putting it to a vote.

Malleability has a few big downsides. It limits what America can offer. A cut in tariff rates, a plank of most free-trade deals, is a non-starter because it would require congressional support. America still vows to push for strong labour and environmental standards but, unable to offer more access to its vast market, it lacks a key bargaining chip. The durability of the IPEF is also in doubt. Were Mr Trump to return to the Oval Office in 2024, he would not need three days to ditch the framework.

The Biden administration has tried to make a virtue of these limits. Rather than conceiving of the IPEF as a conventional deal, it has declared that the pact will rest on four pillars, with trade promotion just one. The other three goals are to make supply chains more resilient; to promote infrastructure investment and clean energy; and to form new rules on taxation and anti-corruption. It is tempting to dismiss such a wide-ranging agenda as too vague to amount to anything. But paradoxically, a near-stumble at the launch of the framework illustrated that it could, in theory, have force to its contents: America had to tone down the language in its founding documents, otherwise some in Asia would have balked at signing them.

Matthew Goodman of the Centre for Strategic and International Studies, a think-tank, notes that the focus on topics such as digital trade, competition policy and bribery makes for a good menu for the IPEF. "These are issues that are very much in the interest of our partners in the region," he says. At the same time, breadth poses a challenge. Instead of just having the USTR as the lead negotiator, as in normal trade talks, the Commerce Department is in charge of the non-trade portfolio. That risks turning it into a multi-headed beast.

For now, many in the region are most pleased by the symbolism. The wounds from America's TPP exit are still raw. Since Mr Biden's election victory, allies have waited and waited for America to devise a new Asian trade strategy. At last it has arrived, even if it is more notable for its political constraints than its economic potential. "We are just happy to have them at the table," says one Australian official. ■



再造框架

美国的新亚洲经济协议——总之别叫它贸易协定

中国没获邀加入

在2017年1月宣誓就任总统后仅三天，特朗普就签署了一项行政命令，宣布美国退出《跨太平洋伙伴关系协定》（TPP）。他在竞选时大肆抨击这一有12国参与的自由贸易协定。今年5月23日，拜登在宣誓就任总统488天后公布了一项新协议——有13国参与的《印度-太平洋经济框架》（IPEF），以期逆转特朗普“退群”带来的一些损害。相比之下，拜登推出他的亚洲贸易政策的速度慢多了，这说明了一个基本事实：撕毁协议要比从头制定新协议容易得多。

观察IPEF时，有一个角度无可避免：拿它和TPP（没了美国它依然存在，只是规模缩小）做比较。有关它们的一些说法听起来颇相像。TPP的一大卖点是它是一个“21世纪贸易协定”，并对劳工权利和电子商务规则设定了高标准。而据美国国家安全顾问杰克·沙利文（Jake Sullivan）称，IPEF也是“一个21世纪经济架构”。TPP的创始成员国占到全球GDP的近40%，与目前IPEF成员国的份额大致相同。最关键的是，中国依旧被排除在外。和TPP一样，IPEF试图在亚洲建立一个推崇美国的经济原则及其经济实力的贸易架构。作为对中国影响力的一种制衡，该架构受到地区内许多国家的欢迎。

然而，相似点仅此而已。特朗普当年靠高呼美国不能继续让别国“敲竹杠”赢得了支持，让华盛顿许多人对大型自由贸易协议退避三舍。所以拜登团队没有制定需要国会批准的协议，而是设计了一个可塑性更强、或许可以避开那种政治死局的框架。美国贸易代表戴琪在宣布启动IPEF时承诺，在制定该框架时将“与国会保持密切联系”——这跟付诸表决相去甚远。

可塑性伴有几处明显弊端。它限制了美国可提供的东西。削减关税是大多数自由贸易协议的核心，但这需要国会支持，无望被纳入议题。美国仍在表态要推动劳工和环境高标准，但缺少关键谈判筹码，因为它无法为他国

进入巨大的美国市场提供更多机会。IPEF的持续性也存疑。假如2024年特朗普重回白宫，不用三天他就会废止这个框架。

针对这些限制，拜登政府试图因势利导。它没有把IPEF定位为传统贸易协定，而是宣称该框架将建立在四个支柱上，促进贸易只是其中之一。另外三个目标是：加强供应链韧性；推动基础设施投资和清洁能源发展；制定新的税收和反腐败规则。这些议题涵盖面如此之广，人们很容易不屑地认定它会太过含糊而无所作为。但奇异的是，该框架的启动就已经磕磕绊绊：美国不得不缓和了创始文件中的措辞，否则一些亚洲国家已经拒绝签署这些文件。这表明，协议的内容在理论上是有可能产生实质影响力的。

智库战略与国际研究中心（Centre for Strategic and International Studies）的马修·古德曼（Matthew Goodman）指出，对IPEF来说，专注数字贸易、竞争政策和贿赂等议题是很好的选择。“这些问题非常符合我们的亚洲伙伴的利益。”他表示。同时，涵盖广泛也构成了一种挑战。一般的贸易谈判完全是由美国贸易代表担纲，而这次的非贸易合作部分由美国商务部负责谈判。这有可能让它变为一个多头怪。

目前，最让该地区许多国家满意的是这一框架的象征意义。美国退出TPP留下的伤口尚未愈合。自拜登胜选以来，盟友们一直翘首以盼美国制定新的亚洲贸易战略。现在终于等到了，尽管新框架更引人注目的是其政治约束而非经济潜力。“他们能回到谈判桌前，我们就挺高兴了。”澳大利亚一位官员说。■



Genetic screening

Whole-genome sequencing of newborn babies presents ethical quandaries

It can bring medical benefits—but it could also reveal bad news

IMAGINE FOR a moment that your unborn child has a rare genetic disorder. Not something at least vaguely familiar, such as sickle-cell anaemia or cystic fibrosis, but rather a condition buried deep within the medical dictionary. Adrenoleukodystrophy, maybe. Or Ehlers-Danlos syndrome.

Would you, when your child is born, want to know about it? If effective treatments were available, you probably would. But if not? If the outcome were fatal, would your interest in knowing about it depend on whether your newborn had five years of life to look forward to, or ten? Or 30?

Today these questions are mostly hypothetical. Precisely because they are rare, such disorders are seldom noticed at birth. They manifest themselves only gradually, and often with unpredictable severity. But that may soon change. Twenty years after the first human genome was mapped, the price of whole-genome sequencing has fallen to a point where it could, in rich countries at least, be offered routinely to newborns. Parents will then have to decide exactly how much they want to know.

Early diagnosis brings with it the possibility of early treatment. Moreover, sequencing the genomes of newborns could offer a lifetime of returns. A patient's genome may reveal which drugs will work best in his or her particular case for conditions such as ADHD, depression and cancer. Combined with information about someone's way of life, it could highlight easily discounted health risks such as cancers and cardiovascular disease, leading to better preventive measures. A database of genomes, matched to living people, would be a boon for medical research. The fruits of that

research, in turn, would make those genomes more useful to their owners as time goes on.

Sequencing children's genomes at birth would also create opportunities to develop treatments for rare conditions that are typically discovered too late and in small numbers. There are reckoned to be about 7,000 rare diseases in the world, affecting 400m people, and most are genetic. At the moment they are so unusual as to be unattractive targets for big pharmaceutical firms. With more and earlier diagnoses, that might change.

Such a powerful new technology creates new dangers. Widespread screening for thousands of potentially harmful genes may be counterproductive: some results may worry parents unnecessarily, because some genetic variations, though occasionally indicative of disease, are not strongly so. Parents may not want to unlock all the secrets that their newborn's genome might reveal. Some may indeed prefer not to know about conditions that cannot be treated. Adult-onset illnesses pose a different dilemma—a reasonable position is that it should be up to the children themselves, once grown, to decide whether they want to look at their genomic information. A further concern is that data will not be kept secure, and may be leaked or otherwise misused at some point in the future.

In Britain, where a large project to sequence the genomes of newborn babies is planned to start next year, a consultation process is already grappling with these questions. Some of the broad principles emerging may be applied to similar projects in a number of other European countries, and in America, Australia, China and Qatar. One lesson is to start conservatively. The British project is likely to begin with a small number of extremely reliable tests that will improve the way children are treated. This ensures the testing is for the benefit of the child. Tests that are not firmly diagnostic, or which involve much follow-up work, are not a priority.

Control of the data should be passed on to children at adulthood. Finding the time to educate parents, so they can make good decisions, is essential.

It remains to be seen whether the economics of this sort of testing make it feasible on a national scale. These days the cost has less to do with the technical expense of sequencing than with the salaries of those providing the services. But countries that can make this work will be able to start to harness the full potential of the genomic revolution. It began 20 years ago. Soon, it will become part of everyday health care. ■



【首文】基因筛查

新生儿全基因组测序引发伦理困境

这在医学上有好处，但也可能带来坏消息

假设你尚未出生的宝宝患有一种罕见的遗传病。这里的罕见，不是说像镰状细胞性贫血或囊性纤维化这样你多少听说过一点点的疾病，而是一种深藏在医学词典角落里的疾病。比如肾上腺脑白质营养不良，或是埃勒斯-当洛综合征（又称全身弹力纤维发育异常症）。

当你的孩子出生时，你会想知道这件事吗？如果存在有效的治疗方法，你或许想知道。但如果没有呢？如果是致命的疾病，你想知道是否取决于你的宝宝能活五年还是十年？或是三十年？

现在，这些问题大多是假设性的。正因为很罕见，这些疾病在出生时很少会被注意到。它们只会逐渐显现，而且严重程度往往无法预测。但这可能很快就会改变了。在绘制出第一个人类基因组图谱的二十年后，全基因组测序的价格已经大大下降，至少在富裕国家已经可以作为常规服务提供给新生儿。这样一来，父母将不得不决定他们到底想知道多少。

有了早期诊断就有可能尽早治疗。此外，基因组测序可能让新生儿终生受益。一个人的基因组也许能揭示出哪些药物将最具针对性地治疗多动症、抑郁症或癌症等疾病在其身上的表现。结合患者的生活方式信息，它可以凸显容易被忽视的健康风险，如癌症和心血管疾病，从而采取更好的预防措施。一个与活人相匹配的基因组数据库将是医学研究的福音。反过来，随着时间的推移，这方面的研究成果会让这些基因组对其主人更有用处。

在儿童出生时就做基因组测序也能创造机会为罕见病研发疗法，这些疾病通常发现得太晚，而且数量很少。据估计，世界上大约有7000种罕见疾病，影响到四亿人，而且大多数是遗传性的。目前，它们因为太过罕见，对大型制药公司来说没有吸引力。如果有更多、更早期的诊断，这种情形就有可能改变。

这一强大的新技术带来了新的危险。广泛筛查成千上万可能有害的基因也许会适得其反：一些结果可能会引发父母不必要的担心，因为一些基因变异虽然偶尔会是疾病的预示，却并不是可靠的指标。父母也许不想解开他们新生儿的基因组可能包含的所有秘密。有些人可能的确宁愿不知道孩子患有治不了的病。那些到成年才会发作的疾病则导致了另一个困境——一种合情理的观点是应该等孩子长大后自己决定要不要查看自己的基因组信息。另一个担忧是数据得不到安全保护，可能在未来的某个时刻被泄露或滥用。

英国计划于明年启动一个大型新生儿基因组测序项目，已经在就这些难题展开磋商。其中浮现的一些总体原则可能适用于在其他一些欧洲国家，以及美国、澳大利亚、中国和卡塔尔开展的类似项目。第一条经验是开始时谨慎一些。英国的项目很可能从少量非常可靠的、能切实改善对儿童的治疗的测试开始。这么做确保了测试会对孩子有益。一些无法明确诊断或是涉及很多后续工作的测试，都不会被优先考虑。所获数据的控制权应在孩子成年后交给他们自己。要花时间教育父母，让他们能做出正确的决定，这至关重要。

这种测试在经济上是否适合在全国范围内推行还有待观察。如今，主要成本已不是测序技术费用本身，而是测序工作人员的工资。但是，能够开展这项工作的国家就能开始发掘基因组革命的全部潜能。这场革命在二十年前就开始了。很快，它会成为日常医疗保健的一部分。■



Heiferinflation

Why a Zimbabwean firm offers pensions denominated in cows

Ruminants are inflation-proof

KELVIN CHAMUNORWA'S mother was a middle manager at a bank in Zimbabwe. She worked there for 25 years, steadily contributing to a pension. But horrendous inflation, which reached an annual rate of 231,000,000% in mid-2008, wiped out her savings. When she retired, her pension was so small it was barely worth collecting.

So Mr Chamunorwa, an actuary trained in Britain, started a company, Nhaka Life Assurance, to sell inflation-proof pensions to Zimbabweans. The pensions are not denominated in Zimbabwe dollars, since they quickly evaporate, nor in American dollars, since many Zimbabweans are struggling to obtain any.

Instead, they are denominated in cows, which the government can't print. Savers, typically wage-earners such as teachers, chip in cash, which Nhaka immediately turns into cattle. The assets grow by breeding. When a policy matures, clients can demand payment in cows or the cash equivalent.

Zimbabweans have long seen cattle as a store of wealth. Mr Chamunorwa jokes that he has merely updated an old idea and added livestock insurance. His scheme is especially suited to a country where savers have lost all confidence in conventional finance. The only way to rebuild trust is to offer people "things they can touch and see", he says. Nhaka holds viewing days when some of its 70,000 clients can visit the cows.

Mr Chamunorwa also likes to get away from his office in Harare, the capital, and visit them. At Nhaka's farm in Selous, 75km away, he watches newly weaned calves hungrily munching hay, and offers his actuarial opinion.

“Most of these, we’ll be putting a bull on them in 12 months’ time,” he says. That will be “a compounding of the investment return”. ■



高通胀，牛来挡

为什么津巴布韦一家公司提供用牛计价的养老金

牛能抗通胀

凯尔文·沙米诺瓦（Kelvin Chamunorwa）的母亲曾是津巴布韦一家银行的中层管理人员。她在那里工作了25年，一直定期缴纳养老金。但是惊人的通胀（2008年年中时的年通胀率达到231,000,000%）让她的积蓄化为乌有。她退休时，养老金少到几乎不值得花力气领取。

因此，在英国接受了精算师培训的沙米诺瓦创办了一家名为Nhaka Life Assurance的公司，向津巴布韦人出售抗通胀型养老金。这种养老金既不以津巴布韦元计价——因为这种货币会顷刻化为泡影，也不以美元计价，因为许多津巴布韦人都弄不到美元。

它们是用牛计价的，政府可印刷不出牛来。以教师等工薪族为代表的储户存入现金，Nhaka立即把钱换算成牛。这些资产通过养殖牛来增长。当缴满一定年限后，客户可以要求以牛或等值现金支付。

在津巴布韦，牛早就被视为一种保值工具。沙米诺瓦开玩笑说，他只是升级了旧有观念，增加了牲畜保险而已。他的方案特别适合于一个储户对传统金融体系完全失去信心的国家。他说，重建信任的唯一方法是向人们提供“他们看得见、摸得着的东西”。Nhaka举办开放日，它的七万名客户中的一些人可以前往参观奶牛。

沙米诺瓦自己也喜欢走出位于首都哈拉雷（Harare）的办公室，到75公里外的塞卢斯（Selous）看这些奶牛。在那里的公司农场里，他看着刚断奶的小牛狼吞虎咽地咀嚼干草，从精算师的角度给出了意见。“这其中的大部分，我们将在12个月后让它们受孕。”他说。这可是“投资回报的复利”呀。■



War and farming

The coming food catastrophe

War is tipping a fragile world towards mass hunger. Fixing that is everyone's business

By invading Ukraine, Vladimir Putin will destroy the lives of people far from the battlefield—and on a scale even he may regret. The war is battering a global food system weakened by COVID-19, climate change and an energy shock. Ukraine's exports of grain and oilseeds have mostly stopped and Russia's are threatened. Together, the two countries supply 12% of traded calories. Wheat prices, up 53% since the start of the year, jumped a further 6% on May 16th, after India said it would suspend exports because of an alarming heatwave.

The widely accepted idea of a cost-of-living crisis does not begin to capture the gravity of what may lie ahead. António Guterres, the UN secretary general, warned on May 18th that the coming months threaten “the spectre of a global food shortage” that could last for years. The high cost of staple foods has already raised the number of people who cannot be sure of getting enough to eat by 440m, to 1.6bn. Nearly 250m are on the brink of famine. If, as is likely, the war drags on and supplies from Russia and Ukraine are limited, hundreds of millions more people could fall into poverty. Political unrest will spread, children will be stunted and people will starve.

Mr Putin must not use food as a weapon. Shortages are not the inevitable outcome of war. World leaders should see hunger as a global problem urgently requiring a global solution.

Russia and Ukraine supply 28% of globally traded wheat, 29% of the barley, 15% of the maize and 75% of the sunflower oil. Russia and Ukraine contribute about half the cereals imported by Lebanon and Tunisia; for

Libya and Egypt the figure is two-thirds. Ukraine's food exports provide the calories to feed 400m people. The war is disrupting these supplies because Ukraine has mined its waters to deter an assault, and Russia is blockading the port of Odessa.

Even before the invasion the World Food Programme had warned that 2022 would be a terrible year. China, the largest wheat producer, has said that, after rains delayed planting last year, this crop may be its worst-ever. Now, in addition to the extreme temperatures in India, the world's second-largest producer, a lack of rain threatens to sap yields in other breadbaskets, from America's wheat belt to the Beauce region of France. The Horn of Africa is being ravaged by its worst drought in four decades. Welcome to the era of climate change.

All this will have a grievous effect on the poor. Households in emerging economies spend 25% of their budgets on food—and in sub-Saharan Africa as much as 40%. In Egypt bread provides 30% of all calories. In many importing countries, governments cannot afford subsidies to increase the help to the poor, especially if they also import energy—another market in turmoil.

The crisis threatens to get worse. Ukraine had already shipped much of last summer's crop before the war. Russia is still managing to sell its grain, despite added costs and risks for shippers. However, those Ukrainian silos that are undamaged by the fighting are full of corn and barley. Farmers have nowhere to store their next harvest, due to start in late June, which may therefore rot. And they lack the fuel and labour to plant the one after that. Russia, for its part, may lack some supplies of the seeds and pesticides it usually buys from the European Union.

In spite of soaring grain prices, farmers elsewhere in the world may not make up the shortfall. One reason is that prices are volatile. Worse, profit

margins are shrinking, because of the surging prices of fertiliser and energy. These are farmers' main costs and both markets are disrupted by sanctions and the scramble for natural gas. If farmers cut back on fertiliser, global yields will be lower at just the wrong time.

The response by worried politicians could make a bad situation worse. Since the war started, 23 countries from Kazakhstan to Kuwait have declared severe restrictions on food exports that cover 10% of globally traded calories. More than one-fifth of all fertiliser exports are restricted. If trade stops, famine will ensue.

The scene is set for a blame game, in which the West condemns Mr Putin for his invasion and Russia decries Western sanctions. In truth the disruptions are primarily the result of Mr Putin's invasion and some sanctions have exacerbated them. The argument could easily become an excuse for inaction. Meanwhile many people will be going hungry and some will die.

Instead states need to act together, starting by keeping markets open. Earlier this month Indonesia, source of 60% of the world's palm oil, lifted a temporary ban on exports. Europe should help Ukraine ship its grain via rail and road to ports in Romania or the Baltics, though even the most optimistic forecasts say that just 20% of the harvest could get out that way. Importing countries need support, too, so they do not end up being capsized by enormous bills. Emergency supplies of grain should go only to the very poorest. For others, import financing on favourable terms, perhaps provided through the IMF, would allow donors' dollars to go further. Debt relief may also help to free up vital resources.

There is scope for substitution. About 10% of all grains are used to make biofuel; and 18% of vegetable oils go to biodiesel. Finland and Croatia have weakened mandates that require petrol to include fuel from crops. Others

should follow their lead. An enormous amount of grain is used to feed animals. According to the Food and Agriculture Organisation, grain accounts for 13% of cattle dry feed. In 2021 China imported 28m tonnes of corn to feed its pigs, more than Ukraine exports in a year.

Immediate relief would come from breaking the Black Sea blockade. Roughly 25m tonnes of corn and wheat, equivalent to the annual consumption of all of the world's least developed economies, is trapped in Ukraine. Three countries must be brought onside: Russia needs to allow Ukrainian shipping; Ukraine has to de-mine the approach to Odessa; and Turkey needs to let naval escorts through the Bosphorus.

That will not be easy. Russia, struggling on the battlefield, is trying to strangle Ukraine's economy. Ukraine is reluctant to clear its mines. Persuading them to relent will be a task for countries, including India and China, that have sat out the war. Convoys may require armed escorts endorsed by a broad coalition. Feeding a fragile world is everyone's business. ■



【首文】战争和农业

粮灾将至

战争正把脆弱的世界推向大饥荒。解决这个问题需要全球共同行动

普京入侵乌克兰会毁了很多远在战场之外的人的生活——范围之大恐怕连普京自己都会感到后悔。全球粮食体系已经因新冠肺炎、气候变化和能源价格剧烈震荡而被削弱，而今又受到俄乌战争的沉重打击。乌克兰已经基本上停止了谷物和油籽的出口，俄罗斯的出口也无法保证。这两个国家合计供应了全球粮食贸易的12%。自今年年初以来小麦价格已上涨53%，在印度宣布迫于骇人热浪将暂停出口后，小麦价格在5月16日又上涨了6%。

普遍的看法是人们面临一场生活成本危机，但这还远没有认识到可能来袭的糟糕局面。联合国秘书长古特雷斯在5月18日警告说，未来几个月很可能出现“全球粮食短缺的恐慌”，并且可能会持续数年挥之不去。高企的主粮价格已经让吃了上顿没下顿的人较之前增加了4.4亿，达到16亿。近2.5亿人处于饥荒的边缘。如果战争持续下去，俄罗斯和乌克兰的粮食出口受到限制（这很有可能发生），可能再有几亿人落入贫困。有更多地区会陷入政治动荡，儿童会发育不良，人们会挨饿。

普京绝不可把粮食用作武器。战争并不必然导致粮食短缺。各国领导人应把饥荒视为一个亟待全球群策群力的世界性问题。

俄罗斯和乌克兰供应了占全球贸易量28%的小麦、29%的大麦、15%的玉米以及75%的葵花籽油。黎巴嫩和突尼斯的谷物进口大约有一半来自俄罗斯和乌克兰，而利比亚和埃及的这一数字达到三分之二。乌克兰出口的粮食养活了四亿人。俄乌战争破坏了粮食出口——为了阻止进攻，乌克兰在自家水域布下了水雷；而俄罗斯正在封锁港口敖德萨（Odessa）。

甚至早在俄罗斯入侵乌克兰之前，世界粮食计划署就警告称2022年将是糟糕的一年。那时全球最大的小麦生产国中国已经表示，由于去年持续降雨导致晚播，这一季的收成可能是有史以来最差的。如今，除了世界第二大

小麦生产国印度正经历极端气温，雨水不足也可能让从美国的小麦种植带到法国博斯（Beauce）地区的其他产粮区减产。非洲之角正遭受40年来最严重的干旱。欢迎进入气候变化时代。

所有这一切将会严重伤害穷人。新兴经济体里的家庭25%的开支都花在食品上，在撒哈拉以南非洲地区更是高达40%。在埃及，面包提供了30%的卡路里。许多粮食进口国的政府无力提供补贴，无法增加对穷人的帮助，尤其是有些国家同时还是能源进口国——能源市场目前也在动荡不安中。

粮食危机有进一步恶化的危险。乌克兰在战争爆发前已经运走了去年夏天生产的大部分粮食。尽管运输的成本和风险上升，俄罗斯仍在设法销售粮食。但是，那些没有受到战火破坏的乌克兰粮仓里装满了玉米和大麦。当农民们预定在6月下旬开始下一季的收割时，打下的粮食可能会因为没地方储存而烂掉。而且他们也缺乏种植下一季作物所需的燃料和人手。至于俄罗斯，它可能缺乏一些通常购自欧盟的种子和农药。

尽管粮食价格飙升，世界其他地区的农民可能无法补上缺口。一个原因是价格波动。而更糟糕的是，由于化肥和能源的价格飙升，种粮的利润在缩减。这两方面的支出占了种植成本的大头，而两个市场都被制裁和对天然气的争夺扰乱。如果农民减少在化肥上的开支，全球粮食产量将在最不该下降的时候下降。

忧心忡忡的政客们做出的反应可能会让情况变得更糟。自开战以来，已经有哈萨克斯坦、科威特等23个国家宣布实施严格的粮食出口限制措施，占到全球贸易量的10%。全球超过五分之一的化肥出口受到限制。如果贸易中断，饥荒就会随之而来。

这种局面会引发相互甩锅——西方谴责普京入侵，俄罗斯指斥西方制裁。事实上，造成这种乱局的首要原因是普京的入侵，而一些制裁又加剧了这种混乱。争吵很容易成为不作为的借口。与此同时，很多人会挨饿，一些人会饿死。

而各国需要做的是共同行动，先从保持市场开放开始。本月稍早前，供应

了全世界60%的棕榈油的印度尼西亚解除了一项临时出口禁令。欧洲应该帮助乌克兰通过铁路和公路将粮食运往罗马尼亚或波罗的海沿岸的港口，尽管即便最乐观的预测也认为只有20%的收成可以通过这种方式运送出去。各个粮食进口国也需要援助，这样它们才不会被巨额账单压垮。紧急粮食供应应该只提供给最贫穷的国家。对其他国家，以优惠条件提供的进口贸易融资（或许是通过国际货币基金组织）将让捐助者的资金发挥更大作用。债务减免可能也有助于腾挪出重要的资源。

要寻找替代品也是有余地的。目前全球大约10%的谷物被用来制造生物燃料，18%的植物油被转化为生物柴油。芬兰和克罗地亚已经放松了要求燃油中必须包括一定比例的农作物燃料的规定。其他国家应该效仿它们。大量谷物被用于饲养动物。根据联合国粮农组织的数据，13%的养牛干饲料是谷物。2021年，中国为养猪进口了2800万吨玉米，超过乌克兰一年的出口量。

打破黑海封锁会立刻缓解困境。目前困在乌克兰运不出去的玉米和小麦大约有2500万吨，相当于全球所有最不发达经济体一年的消费量。打通航路必须同时获得三个国家的支持：俄罗斯得要允许乌克兰运粮；乌克兰必须清理通往敖德萨的航路上的水雷；土耳其需要允许护航舰艇通过博斯普鲁斯海峡。

这并不容易做到。战场上处境艰难的俄罗斯正试图扼杀乌克兰的经济。乌克兰不愿清除水雷。说服俄乌双方做出让步将是印度和中国等持观望和中立态度的国家的一个任务。运粮船队可能需要得到由一个广泛联盟支持的军舰护航。养活一个脆弱的世界人人有责。■



Recession watch

Global growth is slowing, but not stopping—yet

The Chinese and Russian economies, though, are probably shrinking

Since 1900 the global economy has fallen into recession, as defined by a year-on-year decline in GDP per person, about once a decade on average. In 2020 the world experienced the deepest downturn since the end of the second world war. Just two years on, is another recession on the way?

Worries are certainly mounting. The war in Ukraine has triggered higher food and energy prices, which have hammered households' disposable incomes. Lockdowns in China are disrupting supply chains. And central banks are rapidly raising interest rates to tame inflation.

Fears about the state of the world economy have jolted financial markets. In the past month stockmarkets in rich countries have fallen by more than a tenth. Risky assets, including tech stocks and cryptocurrencies, have taken a nasty blow. Economists, meanwhile, are steadily downgrading their forecasts for global growth. To what extent are recession fears already materialising? A look at the data gives grounds for cautious optimism—for now, at least.

True, in many places people sound as though the recession is already here. Across the OECD, a club mostly of rich countries that accounts for more than 60% of global GDP, consumer confidence is now lower than it was when the coronavirus first struck (see chart 1). A gauge of American consumers' sentiment constructed by the University of Michigan this month fell to its lowest level in a decade, according to a preliminary estimate. Respondents were gloomier about their own financial situations; fewer of them thought it a propitious time to buy durable goods, on account of high inflation. If consumers hold back from spending, the

economy will slow.

Yet, so far, what people say and what people do seem to be different things. Global restaurant bookings on OpenTable, a reservations website, are still above the pre-pandemic norm. In America retail sales are still increasing, and hotel occupancy continues to improve. A high-frequency measure of Britons' spending habits, constructed by the Office of National Statistics and the Bank of England, shows little sign that people are holding back from social activities, or from purchases that could be deferred.

Consumers are likely to be able to carry on spending for a while, even as inflation cuts into purchasing power. Households across the OECD are still sitting on roughly \$4trn of savings (worth 8% of GDP) accumulated during the pandemic, according to our estimates. And, contrary to what is commonly supposed, not all that money is in the hands of the rich. In America the bank accounts of low-income families were still 65% fatter at the end of last year than in 2019.

Businesses too look resilient for now. Rising costs are hitting the profits of some retailers. But the OECD's measure of business confidence remains solid. Data from Indeed, a jobs site, suggest that vacancies in rich countries may have stopped increasing—but they are still plentiful. There remains appetite for investment, too. Analysts at JPMorgan Chase, a bank, reckon that global capital spending rose by 7.6% in the first three months of the year, compared with the same period the year before—twice its rate towards the end of 2021.

Some countries do look weak. Goldman Sachs, another bank, produces a “current-activity indicator”, a high-frequency measure of economic growth based on a combination of surveys and official data. The Russian economy has sharply slowed since Western countries slapped on sanctions in response to the invasion of Ukraine. And in China, where the government's

zero-covid strategy has led to the strictest lockdowns since early 2020, the economy may well be shrinking (see chart 2).

But most places are stronger. Adapting a weekly GDP series for 45 countries, including India, Indonesia and the G7, produced from internet-search data by Nicolas Woloszko of the OECD, we estimate that global GDP growth has remained steady in recent weeks (see chart 3). Overall, Goldman's measure of economic activity is lower than it was in early 2021, when economies reopened, but it is still respectable.

The data could yet shift—if Russia turns off the gas taps to Europe, China tightens lockdown restrictions further or central banks are forced to raise interest rates faster than they currently expect. When America's labour market has been this tight in the past, notes JPMorgan, a recession has tended to follow in “the medium term”. But the 12th global recession since 1900 does not seem to have started just yet. ■



衰退观察

全球增长放缓，但未停步——暂时没有

不过中国和俄罗斯的经济很可能在萎缩

以人均GDP同比下降来定义衰退，那么自1900年以来，全球经济平均每十年就会陷入一次衰退。2020年，全球经济经历了二战结束以来最严重的滑坡。才过了两年，另一场衰退就又来了吗？

担忧肯定在加剧。乌克兰战争引发食品和能源价格上涨，令居民的可支配收入大打折扣。中国的疫情封控正在扰乱供应链。多国央行正在迅速提高利率以抑制通胀。

对全球经济状况的担忧震动了金融市场。过去一个月里，富裕国家的股市下跌超过十分之一。包括科技股和加密货币在内的风险资产严重受挫。与此同时，经济学家还在不断下调对全球增长的预测。对衰退的担忧在多大程度上已经成为现实？看看数据会让我们有理由保持谨慎乐观——至少目前是这样。

诚然，在许多地方，人们的论调听起来好像经济衰退已经到来。主要由富裕国家组成的经合组织占全球GDP的60%以上，其成员国现在的消费者信心低于疫情爆发之初的水平（见图表1）。初步估计显示，密歇根大学编制的美国消费者信心指数本月降至十年来的最低水平。受访者对自己的财务状况更加悲观。由于通胀飙高，认为现在是购买耐用品的合适时机的人变少了。如果消费者收紧支出，经济将放缓。

不过，目前看来，人们似乎言行不一。预订网站OpenTable上的全球餐厅预订量仍高于疫情前的正常水平。在美国，零售额仍在增长，酒店入住率继续提高。由英国国家统计局和英国央行编制的一个关于英国人消费习惯的高频指标显示，没什么迹象显示人们正在减少社交活动或推迟购买不急用的东西。

即使通胀削弱了购买力，在一段时间内消费者应该仍能够继续花钱。根据我们的估计，经合组织成员国的家庭目前仍存有疫情期间积累的约四万亿美元储蓄（相当于GDP的8%）。而且，与普遍的认知相反，这些钱并不是都握在富人的手中。在美国，低收入家庭去年底银行账户中的钱仍比2019年时多65%。

企业眼下看起来也很有韧性。不断上涨的成本正在挤压一些零售商的利润，但经合组织衡量商业信心的指标仍然表现稳健。招聘网站Indeed的数据表明，富裕国家的职位空缺可能已经停止增加，但仍然很多。投资意愿也依然存在。摩根大通的分析师估计，与去年同期相比，今年前三个月全球资本支出增长了7.6%，是2021年底增幅的两倍。

有些国家的经济看起来确实疲弱。另一家银行高盛编制了一个“当前活动指标”，这是一个结合了调查和官方数据的高频经济增长指标。自西方国家因俄罗斯入侵乌克兰而对其采取制裁措施以来，俄罗斯经济急剧放缓。在中国，政府的清零政策导致了自2020年初以来最严格的封控，经济很可能正在萎缩（见图表2）。

但是大部分地方都更强劲。经合组织的尼古拉斯·沃洛斯科（Nicolas Woloszko）根据互联网搜索数据为包括印度、印尼和七国集团在内的45个国家建立了一个每周GDP指数。本刊在此基础上做调整后，估计全球GDP增长在最近几周保持稳定（见图表3）。总体而言，高盛得出的经济活动水平低于2021年初经济重启时的水平，但仍然可观。

如果俄罗斯关闭通往欧洲的天然气管道，中国进一步收紧封控措施，或者各国央行被迫以快于目前预期的速度加息，数据还可能会发生变化。摩根大通指出，过去美国劳动力市场出现如今这样的吃紧状况时，“中期”内往往会出现衰退。但自1900年以来的第12次全球衰退似乎尚未开始。■



Eternal life

Who wants to live for ever? Quite a lot of people

In “The Price of Immortality”, Peter Ward shows how they are going about it

The Price of Immortality. By Peter Ward. Melville House; 288 pages; \$28.99 and £20

ETERNAL LIFE, in heaven or through reincarnation on Earth, is promised by many faiths. For a simple reason: it eases the fear of death. The idea of living for ever has other devotees, too. It is now pursued by a motley crew of fringe scientists, cultish groups and tech billionaires, united by a conviction that a way to make humans immortal will eventually be found. Meanwhile they pin their hopes on experimental, often fraudulent therapies that promise rejuvenation.

In “The Price of Immortality”, Peter Ward, a journalist who has written for *The Economist*, delves into the origins of these beliefs and the science of purported cures for ageing. He spends time with groups such as the Church of Perpetual Life in Florida, where congregants discuss food supplements and cryonics (the freezing of bodies at death in the hope that they can be revived later).

America’s “immortalists”, he discovers, are inspired by the dreams of futurists such as the science-fiction writer Isaac Asimov. Another influence is Nikolai Fedorov, a 19th-century Russian philosopher who thought all living beings could, one day, be resurrected using traces of them floating around in the cosmos—a vision that brings to mind modern DNA cloning.

“Longevity escape velocity” is one of the immortalists’ central tenets. This notion holds that if science manages to extend the human lifespan by 20 or 30 years—to around 110 or 120—it will then rise exponentially as new

techniques are developed in time to keep the wizened going longer and longer. The hypothesis was floated in 2004 by Aubrey de Grey, a British scientist prominent in the field of age-reversal, whose work caught the attention of Silicon Valley moguls.

This is not all pure fantasy. Gene and stem-cell therapies and other types of regenerative medicine can tackle some of the ways in which ageing causes natural deterioration—though these methods are yet to be turned into proven and safe treatments. That may not take long, though. Tech magnates such as Sergey Brin and Larry Page, the co-founders of Google, and Jeff Bezos of Amazon have been pouring money into longevity research. Some of the startups conducting it have billions of dollars at their disposal and are poaching leading scientists. As an investor tells Mr Ward, the goal is extending healthy life spans, not freezing decrepit bodies that might “wake up in 200 years from now and commit suicide if they can”.

Some immortalists back an even more radical aim: doing away with the body and resurrecting a dead person’s mind in a robot or through some form of digital alternative reality. The theory is that this could be accomplished using scans of brain tissue, or by applying artificial intelligence to reconstruct a personality from “mindfiles”—vast amounts of digital data accrued during the subject’s life. Tech titans are bankrolling this moonshot, too. Digital immortalists, like adherents of cryonics, accept that the chances of success are slim; but they are willing to put in the work and money anyway.

Mr Ward combines thorough reporting and lucid scientific explanations in a fluent and balanced account of a diverse movement. From the tragicomedies of cryonics’ early years, to tales of scam artists and reckless zealots, he is a vivid storyteller. And he ponders a world in which people do indeed live a lot longer. Even if old age is made healthier, drastic new kinds of inequality—and political strife—could result. If scientists succeed in

making death optional, concludes Mr Ward, resolving such issues will be a prerequisite for a “world worthy of a longer stay”. ■



永生

谁想永生？还挺多人的

彼得·沃德讲述了这些人是如何追求永生的【《不朽的代价》书评】

《不朽的代价》，彼得·沃德著。梅尔维尔出版社，288页；28.99美元/20英镑。

许多宗教信仰都许诺人们将在天堂或通过在人间的轮回获得永生。原因很简单，这能减轻人们对死亡的恐惧。永生的想法也有其他追随者。现在，从非主流科学家、邪教团体，到科技亿万富翁的各色人等都在追求永生，他们都坚信最终能找到让人类不朽的方法。与此同时，他们将希望寄托在号称能让人青春永驻的实验性疗法上，而这些疗法很多是在骗人。

在《不朽的代价》（The Price of Immortality）一书中，为本刊撰稿的记者彼得·沃德（Peter Ward）深入探究了这些永生信仰的起源以及据声称可抗衰老的科学。他与佛罗里达州的永生教会（Church of Perpetual Life）等团体共处，听他们探讨食品补剂和人体冷冻法（死亡时冷冻尸体，以期日后复活）。

沃德发现，美国的“不朽主义者”所受的启发来自科幻小说作家艾萨克·阿西莫夫（Isaac Asimov）等未来主义者的梦想。另一个对他们产生影响的人是19世纪的俄罗斯哲学家尼古拉·费多罗夫（Nikolai Fedorov），他认为有朝一日，所有生物都可以通过它们弥散在宇宙中的痕迹复活，这一愿景让人联想到现代DNA克隆。

“长寿逃逸速度”是不朽主义者的核心信条之一。这种理论认为，如果科学能设法将人类寿命延长二十或三十年，也就是可以活到约110或120岁，那么随着及时研发出来的新方法不断延长老年人存活的时间，寿命将呈指数级增长。2004年，在逆生长领域享有盛誉的英国科学家奥布里·德·格雷（Aubrey de Grey）提出了这一假设，他的研究引起了硅谷大亨的注意。

这不纯粹是幻想。基因和干细胞疗法以及其他的再生医学可以阻止某些因年龄增长导致的自然老化，不过这些方法尚未转化为经过验证且安全的疗法。不过，这可能用不了多久了。谷歌的联合创始人谢尔盖·布林（Sergey Brin）和拉里·佩奇（Larry Page）以及亚马逊的贝索斯等科技巨头一直在向长寿研究投入资金。一些开展这类研究的创业公司有数十亿美元的资金可供支配，并且正在挖走顶尖的科学家。正如一位投资者告诉沃德的那样，这类研究的目标是延长健康寿命，而不是冷冻年迈体衰的老人，让他们可能“过个200年醒过来，还能自己动手的话再自杀”。

一些不朽主义者支持一个更激进的目标：不保留躯体，而是通过机器人或某种形式的数字替代现实来复活死者的思想。理论上，这可以通过扫描脑组织完成，或者应用人工智能从“思维文件”中重建人格，这些文件是死者一生中积累起来的大量数字数据。科技巨头也在为这项揽月摘星式的研究注资。和人体冷冻法的拥趸一样，数字不朽主义者明白成功的机会微乎其微，但无论如何都愿意投入精力和金钱。

沃德的新书既有全面的报道，又有清晰的科学解释，对各式各样的永生研究娓娓道来，不偏不倚。从早期人体冷冻的悲喜剧，到骗徒和不顾一切的狂热分子的故事，他的讲述生动形象。他认真思考了人类寿命大大延长的世界将会如何。即使人们的晚年能变得更健康，也仍可能出现严重的新型不平等和政治冲突。沃德总结说，如果科学家成功地让死亡不再不可避免，解决这些问题将是“值得在这个世界停留更久”的先决条件。■



Bartleby

The woolliest words in business

Innovation. Sustainability. Purpose. Yuck

FIRE-FIGHTING FOAM starves the flames of oxygen. A handful of overused words have the same deadening effect on people's ability to think. These are words like "innovation", "collaboration", "flexibility", "purpose" and "sustainability". They coat consultants' websites, blanket candidates' CVs and spray from managers' mouths. They are anodyne to the point of being useless.

These words are ubiquitous in part because they are so hard to argue against. Who really wants to be the person making the case for silos? Which executive secretly thirsts to be chief stagnation officer? Is it even possible to have purposelessness as a goal? Just as Karl Popper, a philosopher, made falsifiability a test of whether a theory could be described as scientific, antonymy is a good way to work out whether an idea has any value. Unless its opposite could possibly have something to recommend it, a word is too woolly to be truly helpful.

Woolliness is the enemy of accuracy as well as utility. A word like "sustainability" is so fuzzy that it is used to encompass everything from a business that thinks sensibly about the long term to the end of capitalism. This column may well count as sustainable because it keeps recycling the same ideas. The lack of precision opens the door to grandstanding and greenwashing. Earlier this year Morningstar, a data provider, culled 1,200 funds from its European sustainable-investment list after a closer review of their prospectuses and annual reports. Regulators in America and Europe have been scrambling to define standards of sustainability disclosure.

Woolliness also smothers debate about whether you can have too much of a

good thing. Take “innovation”, for example. Too much innovation can be a turn-off for customers. A recent paper from Yingyue Luan and Yeun Joon Kim of the Judge Business School at the University of Cambridge looks at the effect of perceived novelty on the response of audiences to films. The researchers find that there is a sweet spot in experimentation, where films are distinctive enough to pique curiosity but not so radical that they up-end expectations. In that space between “Home Alone 4” and “Tenet” lie the real moneymaking opportunities.

Innovation can also be trying for employees. Researchers at the Massachusetts Institute of Technology (MIT) recently looked at factors that predicted high levels of attrition among companies’ workforces. To their surprise, they found that employees were more likely to leave firms—like Tesla and Nvidia—with high levels of innovation. The authors hypothesise that the long hours and high pressure that typify innovative cultures can lead to higher staff turnover.

“Collaboration” is another word that repays closer scrutiny. It can be marvellous: boundaries dissolved, expertise and ideas flowing. But collaboration can also run wild. It often means having more and more people on every email thread and in every meeting. It can paralyse decision-making, as everyone and their dog gets to weigh in with their view. (To be fair, the dog often makes the most useful points.)

And the rewards that flow from collaborativeness are uneven. “The No Club”, a new book by Linda Babcock, Brenda Peyser, Lise Vesterlund and Laurie Weingart, examines the disproportionate amount of “non-promotable work” done by women—tasks like covering absences, organising logistics and mentoring. Collaboration is a much less attractive proposition if helping others means spending less time on the sort of work that gets recognised when it is time to hand out actual promotions.

A host of other woolly words also mask genuine trade-offs. The supremely fluffy notion of “purpose” disguises hard-edged questions of how managers should balance the interests of multiple stakeholders. “Flexibility” sounds like a boon to workers, but the reality for employees of coping with last-minute changes to schedules is often very different. The MIT study found that having a regular schedule was six times more powerful as a predictor of blue-collar-employee retention than having a flexible schedule.

Traits like innovativeness or collaborativeness are still qualities for firms to aspire to. And this is not an argument for constant qualification of what is meant: the one way to make “purpose” more annoying is to put the word “smart” in front of it. But it is a plea for managers to use woolly words thoughtfully. They are not going away, but they do not have to suffocate mental activity. ■



巴托比

最空泛的商界辞令

创新。可持续。使命。呃

消防泡沫通过隔绝氧气熄灭火焰。有些陈词滥调同样能让人头脑窒息，比如“创新”、“协作”、“弹性”、“使命”、“可持续”，等等。它们占领了咨询公司的网站，充斥了求职者的简历，从主管们口中喷薄而出。它们如此不痛不痒，已经毫无用处。

这些词泛滥成灾，原因之一是很难反驳它们。有谁真的愿意当那个主张大家都各自为政的人？有哪个高管会暗中想成为“首席停滞官”？有可能把“无目的使命”当做目标吗？正如哲学家卡尔·波普尔（Karl Popper）用可证伪性来检验命题是否科学，反义词是检验一种理念是否真有价值的好方法。如果一个词的反义词不能反衬它有什么可推崇之处，那么这个词就模糊不清，没什么真正用处。

模糊不仅是功用的大敌，也与准确背道而驰。“可持续”这种词模糊到可以无所不包，从企业理性考虑长远发展到讲述资本主义的终结。本专栏可能也算得上可持续了，因为一直在反复探讨同样的观点。缺乏精准为假大空和“漂绿”大开方便之门。今年早前，数据供应商晨星（Morningstar）在仔细审查了一系列基金的认购章程和年报后，从其欧洲可持续投资基金列表中剔除了1200只基金。美国和欧洲的监管机构一直在抓紧界定可持续信息披露的标准。

模糊也扼杀了对“过犹不及”的思辨。比如“创新”。创新过度可能反而会败了顾客兴致。剑桥大学嘉治商学院（Judge Business School）的栾映月（音译）和金言俊（音译）最近发表的一篇文章探讨新奇感对人们观影反应的影响。他们发现在尝试实验手法时存在一个最佳平衡点，能让影片的独特足以激发观众的好奇心，却又不会过于激进以至颠覆预期。让票房大卖的机会存在于《小鬼当家4》和《信条》这两极之间的某处。

创新也许还会让员工觉得煎熬。麻省理工学院的研究人员最近研究了会导致员工高流失率的因素。他们惊讶地发现，特斯拉和英伟达这类高度创新的公司更可能流失员工。研究人员推测，创新文化中常见的工时长、压力大会推高员工流失率。

“协作”是另一个值得细究的词。协作可以是绝妙的：界限消除了，专业知识和创意自由流动。但是协作也可能变得混乱失控。协作往往意味着每一串邮件讨论和每一场会议的参与者越来越多。人人都要插嘴表达看法，决策可能因而陷入瘫痪。（说句公道话，往往是小角色们提的意见最有用。）

而且协作带来的回报并不均衡。琳达·巴布科克（Linda Babcock）、布伦达·佩瑟（Brenda Peyser）、莉斯·韦斯特隆德（Lise Vesterlund）和劳里·温加特（Laurie Weingart）合著的新书《徒劳俱乐部》（The No Club）研究了女性承担了太多“非晋升性工作”的情况，比如代班、组织后勤和指导新人等。如果帮助他人会减少做那类在升职评估时可被一眼看到的工作的时间，那么号召大家协作的说服力就会大大降低。

其他一堆含糊其辞的词语也掩盖了真正的得失取舍。“使命”一词极为空洞，掩盖了管理者应如何平衡众多股东之间利益的尖锐问题。“弹性”听来像是员工的福音，但实际情况往往是员工总是要应对工作安排临时生变。麻省理工学院的那项研究发现，相比弹性工作安排，固定的工作安排更能留住蓝领员工，几率是前者的六倍。

创新、协作等特质仍是企业可以也应当追求的。这里也不是要提倡不断限定这些词的含义：让“使命”一词更讨人厌的是在它前面加上“英明”二字。但我们呼吁公司主管们慎用这些空泛的词汇。它们不会消失，但也不要让它们扼杀了思考。■



Wanghong art

Social media are changing the way art is seen and presented

The marriage of art and apps is especially conspicuous in China

ON A WINTRY weekend, young couples wander through “LOVELOVELOVE”, an exhibition at the Today Art Museum in Beijing. Some of the items on display are tenuously related to the theme, but the visitors seem not to mind, intent as they are on snapping a striking selfie amid the mirrors and neon lights. A young woman poses on a white staircase, peeking over her shoulder at her friend’s camera.

Elsewhere in the museum “Bord de Mer”, a film by Agnès Varda, a late French director, plays on a loop. The floor of the gallery has been covered in sand; deckchairs are set up in front of a screen showing gently lapping waves. Viewers discuss the best angle for a picture. Each has around ten seconds to rush into a chair, simulate a relaxing beach scene and get out of the way. Experiencing love, or Varda’s sea view, seems less important than showing others that you have experienced it.

Galleries across the world are attracting snap-happy youngsters eager to impress their online followers. Immersive exhibitions of the art of Yayoi Kusama and Vincent van Gogh have drawn camera-wielding crowds from Melbourne to New York. But in China the marriage of art and social media is especially conspicuous. The country’s private museums have long been subject to oversight by local bureaucrats. Increasingly, however, curators are as beholden to the whims of online taste makers and fads as they are to the censors. Old assumptions about power in the art world are being overturned. More and more it is the crowd, not the experts, who determine the status of artworks.

The word wanghong roughly means “viral” or “internet famous”, with a hint of tackiness. As a noun, it can refer to China’s social-media influencers, otherwise known as “key opinion leaders” (KOLs). As an adjective, it describes hotspots to which young Chinese flock to take selfies, urging their followers to “da ka”, or check in, at the same place: the phrase basically means “been there, done that”, says Cathy Cao, a 22-year-old KOL. “It validates that you are on the trend and that you aren’t left behind.” The wanghong location might be a café, a tree—or, quite often, an art gallery.

The wanghong effect can be mutually beneficial. Reliant on ticket sales as they are, many private art museums welcome it. Galleries often hike their prices in anticipation of wanghong-inspired demand. Philip Tinari, director of the UCCA Centre for Contemporary Art in Beijing, says his institution “has evolved to embrace” KOLs, who are invited to private views. A partnership with Douyin—the inside-China version of TikTok—means UCCA’s shows are promoted to its 600m daily users.

As marketing, it works. Mr Tinari says UCCA has seen a boost in visitor numbers since it began thinking hard about social media. A recent exhibition on Maurizio Cattelan, an Italian artist, was crammed with wanghong devotees, thanks to a promotional push that included social-media competitions, KOLs and Chinese pop idols. Search for the show on Xiaohongshu, a photo-sharing app, and you find posts advising visitors to sport dark colours to complement its neutral palette. In their pictures they lie languidly beside a stuffed horse, a sign reading “INRI” (the Latin abbreviation for “Jesus of Nazareth, the King of the Jews”) jutting out of its flank.

Much more than in Western galleries, these visitors tend to be young—and, says Mr Tinari, they “don’t have this accumulated austerity” in their approach to art. Many private contemporary-art galleries and museums in

China are young too, and attitudes in and towards them are different; the Western etiquette of hushed tones and awed deference is absent. Although many visitors want to explore and learn, these are also places to hang out and have fun.

These technological and demographic shifts are opening up old debates about the role and value of art. What is it for, diversion or edification—and who has the authority to say? For centuries, museums, curators and collectors have judged what is enduring and what is schlock. They sought to interpret the intentions, influences and contexts of each piece. On social media, that hierarchy is upended and scholarly exposition discarded. Here, says Mr Tinari, “everyone has a perspective, and that perspective has some degree of validity.”

Some internet celebrities seem to care about art for art’s sake. Ms Cao’s feed on Weibo, a microblogging service on which she has over 267,000 fans, is a mix of museum selfies and photos of the works. She does not post lengthy captions about the artists or canvases, but strives to “take pictures that can really show the glamour and the beauty of the artwork”, and to dress in “harmony” with the exhibits. But detractors of the wanghong trend argue that paintings and sculptures are being relegated to a mere backdrop for marketing. The art itself is receding from view.

Concern, or snobbery, about seriousness and expertise is not the only objection to the rise of wanghong art. Curators dislike it when KOLs paid to promote clothing or perfumes stage photoshoots in their museums. A few are discouraging the practice, banning visitors from taking pictures with people in them, or asking KOLs to delete them when they do.

But dissenters are in a shrinking minority. Mr Tinari says shows that prioritise photo opportunities are being put on “all over the place” (though not by UCCA, he insists). The curators of an exhibition of Man Ray’s

photography at the M Woods museum in Beijing installed artificial grass and a tree as aids to posing. The Fosun Foundation in Shanghai posted an article on WeChat, another app, encouraging visitors to exploit the interplay of light and shadow in certain rooms. The Museum of Art Pudong, also in Shanghai, has publicised the top selfie spots in and around the building.

In China and beyond, apps with hundreds of millions of users will increasingly shape the ways visual art is displayed and consumed—and ultimately, because artists want their work to be seen and bought, how it is created. When Ms Cao promoted an exhibition of Raphael’s work in Beijing, the vast majority of comments remarked on her appearance rather than the art. Piggybacking on her post, the organisers promised that visitors to the show “may come across beautiful people like her”. ■



网红艺术

社交媒体正在改变艺术的观赏和呈现

艺术和应用的结合在中国尤为突出

在一个寒冷的冬日周末，年轻的情侣们漫步在北京的今日美术馆，参观在那里举办的《爱的艺术》展览。部分展品与主题关系不大，但参观者似乎不以为意，反正他们只是想在一些镜子和霓虹灯中捣鼓出一张厉害的自拍。一名年轻女子在白色的楼梯上摆好姿势，扭过头来向朋友的镜头投去一瞥。

馆内其他地方循环播放着已故法国导演阿涅斯·瓦尔达（Agnès Varda）的影片《海边》（Bord de Mer）。展馆的地板上覆盖着一层沙子，一张张帆布躺椅对着一块屏幕，上面播放着海浪轻轻拍打海岸的画面。观众讨论着从哪个角度拍照最好。每人大约有10秒钟的时间冲向椅子，假装在海滩上放松，然后起身离开让给下一个人。体验爱或者瓦尔达的海景这件事的重要性似乎比不上向他人展示你体验过它。

世界各地的艺术馆正吸引着热衷拍照的年轻人，他们渴望在网上收获粉丝的赞叹。从墨尔本到纽约，草间弥生和梵高的沉浸式艺术展吸引了大批举着相机的参观者。但在中国，艺术和社交媒体的联姻尤其突出。中国的私人博物馆长期都受地方官员的监管。然而，策展人在听命于审查者的同时，也越来越多地被网络弄潮儿的突发奇想和一时的风尚牵着鼻子走。关于艺术界权力归属的各种老观点正在被推翻。决定艺术品地位的越来越多的是大众，而不是专家。

| 艺术不老

中文“网红”这个词的大致意思是“病毒式传播”或“在网上很出名”，隐约透着点俗气。它作名词时可以指在中国社交媒体上有影响力的人，也可称为“关键意见领袖”（KOL）。作形容词时描绘那些中国年轻人一窝蜂地前去自拍的热门地点。这些人鼓励自己的粉丝也去“打卡”，也就是签到——这个词的意思基本上就是“去过了”，22岁的KOL凯西·曹（音译）说，“这能

证明你赶上了潮流，没有落伍。”网红地点可能是一家咖啡馆，一棵树，或者常常是一家艺术馆。

网红效应可以互惠互利。私人艺术博物馆依赖门票收入，它们中有许多都欢迎这种合作。艺术馆预期网红会刺激需求，往往会提高价格。北京UCCA尤伦斯当代艺术中心馆长田霏宇（Philip Tinari）表示，他的机构“已经与时俱进地积极拥抱”KOL，邀请他们私下观看预展。尤伦斯还与TikTok的中国大陆版抖音合作，意味着它可以向抖音的六亿日活跃用户推广自己的展览。

作为营销手段，这行之有效。田霏宇说，自从尤伦斯开始认真思索社交媒体营销以来，访客数量增加了。近期一场意大利艺术家莫瑞吉奥·卡特兰（Maurizio Cattelan）的个展挤满了网红信徒，它融合了社交媒体竞赛、各路KOL和中国流行偶像的推广活动起了作用。在照片分享应用小红书上搜索这个展览，可以发现帖文建议访客穿深色系衣服，以配合场馆内的中性色调。在贴主们的照片中，他们慵懒地躺在一匹毛绒马旁边，马的侧腹边伸出一块牌子，上面写着“INRI”，是“拿撒勒人耶稣，犹太人的王”的拉丁文首字母缩写。

与大多数西方艺术馆的访客相比，这些参观者往往很年轻，对待艺术也“没有那种日积月累的严肃古板”，田霏宇说。中国许多展示当代艺术的私人艺术馆和博物馆也很年轻，而参观者对作品和展馆的态度也不同：西方观展礼仪中的轻声细语和敬畏之心无处寻觅。虽然许多参观者想探索和学习，但这些场馆也是人们闲逛和游玩之地。

这些技术和人群构成上的变化重新激活了有关艺术的角色和价值的长久争论。艺术的目的是什么，是消遣还是教化？谁有发言权？几个世纪以来，判断什么是不朽杰作、什么是劣等品的一直是博物馆、策展人和收藏家。他们试图解读每一件作品的意图、影响和背景。在社交媒体上，这样的等级制度被颠覆，学究式的阐释也被抛弃。田霏宇说，在这里，“每个人都有自己的观点，而且这些观点在某种程度上是站得住脚的。”

一些网络名人似乎纯粹是为了艺术而关心艺术。曹女士在微博上有超过26.7万名粉丝，她的发帖有在博物馆的自拍，也有作品的照片。她不发表关于艺术家或画作的冗长解说，而是力求“拍下能够真正展示艺术作品的魅力和美的照片”，并尽量让穿戴与展品“很搭”。但是批评网红潮流的人说，绘画和雕塑正沦为营销的背景，艺术本身正在淡出人们的视线。

对严肃性和专业性的担忧（或优越感）并不是网红艺术兴起面对的唯一反对声音。策展人不喜欢收了钱推广服装或香水的KOL在他们的场馆里拍摄照片。一些艺术馆会阻止这种行为，禁止参观者在馆内留影，或者会要求KOL删除这类照片。

但是反对者占少数，且越来越少。田霏宇说，把提供拍照机会作为优先事项的展览“比比皆是”（不过他坚称尤伦斯不是这样）。在北京的木木美术馆举办的曼·雷（Man Ray）摄影展上，策展人安装了人工草坪和一棵假树，作为摆拍的辅助道具。上海的复星艺术中心在另一个应用微信上发布了一篇文章，鼓励参观者好好利用特定展厅中的光影效果。同样位于上海的浦东美术馆也将楼内和周围的最佳自拍点广而告之。

在中国等地，用户数以亿计的应用将越发能够塑造视觉艺术的展示和消费方式——最终还会影响艺术的创造，毕竟艺术家都希望自己的作品有人看、有人买。当曹女士推广在北京举办的拉斐尔作品展时，绝大多数评论都是针对她的外表，而不是艺术作品。主办者也来蹭她帖子的热度，承诺参观者“可能会遇到像她那样的美人”。■



The tide goes out

The cryptocurrency sell-off has exposed those swimming naked

And investors are beginning to discriminate

Financial aphorisms are trotted out by investors in every financial cycle. Think of “Buy the rumour, sell the fact”, or “Markets can stay irrational longer than you can stay solvent”. These sayings have staying power because they often ring true. Today, amid a general market rout, cryptocurrency assets are collapsing in value, and the aphorism of the moment is “When the tide goes out, you find out who is swimming naked”.

The crypto slump has been brutal. In November the market value of cryptocurrencies was almost \$3trn. That fell to \$2trn by mid-April before plunging by another 35% to just \$1.3trn now. Bitcoin has briefly dipped below \$29,000, its lowest since late 2020. Crypto’s detractors have long argued that it is useless—unless you are a money-launderer or con-artist—and predicted its demise. The crash will convince many that they are right. In fact the picture is rather different: a sorting process is under way, as the dodgiest parts of the crypto world are exposed, while other bits prove more resilient.

The crypto collapse is part of that broader slump. Red-hot inflation is forcing central banks to tighten monetary policy, triggering a sell-off in riskier or long-dated assets. After a heavy sell-off on May 18th, the tech-heavy NASDAQ index is down by 29% from its high. The S&P 500 index has shed “just” 18%.

However crypto is top of the list of speculative assets receiving a drubbing. The sell-off has exposed glaring weaknesses. Consider Terra, an “algorithmic” stablecoin, whose value is backed by another asset, supposedly making it dependable. On paper, users could redeem \$1 of Terra

for \$1 worth of another cryptocurrency, Luna, which would be issued to meet demand. But Luna's price began to slide in early May, putting pressure on the Terra peg. There was a rush to redeem. As Luna's supply ballooned, its price collapsed. On May 10th 350m Luna tokens existed; now 6.5trn do. At its peak, Luna was worth \$40bn and supported \$18bn of Terra. Now it is worthless, and Terra is trading at 10 cents. In hindsight the scheme looks mad.

At the other end of the spectrum is USDC, a stablecoin backed by cash and short-dated Treasury bills which publishes audited financial statements each month. It has done fine. So has Dai, another stablecoin that is backed by crypto and run by algorithms. It has a decent degree of transparency and holds at least 1.5 times as much backing as it needs. The supply of the cryptocurrencies it relies on—USDC and ether—is independently controlled.

In the middle of these two extremes is tether, the biggest stablecoin, which briefly dipped below its par value of \$1 per token on May 12th. It says it is backed by assets like cash, Treasuries and corporate debt, but its disclosure is awful. Tether refuses to reveal the precise asset mix, claiming this is its "secret sauce". It has previously been fined by New York's attorney-general for misleading investors. As the broader market sell-off in the past weeks has intensified, its holders have rightly grown nervous. Since it slipped from its peg, tether holders have redeemed about \$9bn-worth of tokens, approximately 10% of the total.

Investors are now doing what they are supposed to: penalising instruments that are fundamentally flawed or issued by organisations that are badly run. Yet the sell-off has sparked renewed calls for the government to step in. Consumers are in danger of being ripped off. And volatility could yet spill over into the conventional financial system. For example, tether is a key part of the crypto-plumbing and the most liquid base currency for

trading between other crypto assets, and between crypto and conventional ones. If it failed the fallout would be bigger.

Some critics would like the crypto system banned; others would like it heavily regulated, just as banks are; still others want regulation but fear that this might be interpreted as an official endorsement. The trouble is that a draconian crackdown would put at risk the benefits that crypto eventually promises, including new financial products that bypass stodgy banks; innovations in property rights; and the possibility of a less centralised financial system.

So what should governments do? The best path would be to accelerate the process of sorting that is under way. Key to this is more reliable information so that retail users and institutions can guard more effectively against fraud. In particular, stablecoins should be forced to disclose their backing—what the assets are, where they are held and who controls them. Some crypto ventures based outside America are beyond easy reach of its regulators, but Uncle Sam could require the big crypto exchanges in America, which are already regulated, to flag which tokens have met disclosure standards. The saying that springs to mind is “Help the market sort the wheat from the chaff”. ■



【首文】潮水退去

加密货币抛售让裸泳者无处遁形

投资者开始挑挑拣拣

每个金融周期，投资者都会翻出一些金句，比如“买在谣言时，卖在真相后”，或者“市场非理性的时间要长过你撑住不破产的时间”。这些金句能经久流传是因为它们往往听着像大实话。如今，市场一片衰颓，加密货币资产价值崩塌，此刻的金句是“当潮水退去，你就知道谁在裸泳”。

加密货币这波暴跌场面惨烈。去年11月，加密货币市值近三万亿美元，到4月中旬跌至两万亿美元，之后再暴跌35%，现在只剩1.3万亿美元。比特币曾一度跌破29,000美元，是自2020年底以来的最低位。长期以来，加密货币的抨击者认为这东西毫无用处——除非是用来洗钱或欺诈，并预言它必将消亡。这次崩盘会令许多人相信此言不假。但实际情况却是另一回事：加密世界中最不靠牢的成员暴露了出来，其他成员则被证明是更加强韧的，一场优胜劣汰正在上演。

加密货币这波崩盘是此番大市低迷的表现之一。火热的通胀正迫使各国央行收紧货币政策，引发人们抛售风险较大或期限较长的资产。在5月18日的一轮大量抛售后，以科技股为主的纳斯达克指数比高位下滑了29%，相比之下，标普500指数“仅”下降了18%。

然而，遭受最沉重打击的投机性资产是加密货币。这轮抛售让它的弱点暴露无遗。以Terra这款“算法”稳定币为例，它的价值由另一种资产支持，一般认为这能提高其可靠性。理论上，用户可把一美元的Terra兑换成价值一美元的Luna币（另一种加密货币，按需求发行）。但Luna的价格在5月初开始下滑，对挂钩的Terra造成压力。人们争相赎回。Luna币的价格随着供应量膨胀而暴跌。5月10日，Luna币的总流通供应量为3.5亿枚，现在已达到6.5万亿枚。Luna在最高峰时市值曾达400亿美元，撑起了市值180亿美元的Terra。如今它变得一文不值，而Terra的交易价格仅为10美分。回头看来，这是一个疯狂的方案。

在光谱的另一端是USDC，这是一款由现金和短期美国国债支持的稳定币，每月公布经审计的财务报表。USDC的表现不俗。另一种由加密货币支持的算法稳定币Dai也表现良好。它的运作还算透明，而且要求最低1.5倍的抵押比率，作为其抵押品的加密货币（USDC和以太坊）的供应是独立控制的。

在这两个极端的中间是最大的稳定币泰达币。5月12日，泰达币曾一度跌破一美元的面值。泰达币号称由现金、美国国债和公司债等资产支持，但信息披露非常糟糕。它拒绝透露资产组合的具体构成，声称那是自己的“秘方”。泰达币之前曾因误导投资者遭纽约州总检察长罚款。眼看过去几周市场大规模抛售加剧，泰达币的持有者自然越发神经紧绷。自那次短暂脱锚以来，已有价值约90亿美元的泰达币被赎回，占总额的10%左右。

投资者如今正在做该做的事：惩罚那些有着根本性缺陷或由经营不善的机构发行的金融工具。然而，这波抛售引发人们再次呼吁政府介入。消费者面临被欺诈的风险。而且动荡还可能蔓延到传统金融体系。例如，泰达币是加密货币体系的关键部分，也是其他加密资产之间以及加密资产与传统资产之间交易的最具流动性的基础货币。它一旦崩盘，影响会更大。

有批评者希望政府封禁加密货币体系，也有人主张对其严加监管，就像对银行那样。还有人既想要政府监管又担心这可能会被解读为官方背书。棘手的是，严厉管制会抹杀加密货币最终承诺的好处，包括绕过古板守旧的银行推出新金融产品、创新产权模式，以及建立一个不那么集中的金融体系的可能性。

那么政府该怎么做？最佳路径是加快正在进行中的筛选过程。其中的关键是提供更可靠的信息，以便散户和机构投资者更有效地防范欺诈。尤其是要硬性要求稳定币披露抵押品的信息，比如背后的资产是什么，放在哪里，由谁控制。对于一些总部在美国以外的加密货币企业，美国的监管机构鞭长莫及，但美国政府可以要求美国大型加密货币交易所（已受到监管）标记哪些代币符合披露标准。此时此刻，脑中响起的金句是“要帮助市场去芜存菁”。■



Free exchange

The world needs a new economic motor. Could India fit the bill?

The shifting structure of the global economy will make that hard

THE WORLD could use more economic hope. The war in Ukraine has dealt a heavy blow to global growth prospects. Lockdowns and a property slowdown have sapped China, the erstwhile growth engine, of its vim. Given its size and potential, it seems reasonable to ask if India could be the world's next economic motor. In April the IMF reckoned that Indian GDP might grow by more than 8% this year—easily the fastest pace among large countries. Such a rapid expansion, if sustained, would have a profound impact on the world. But, in large part because of the shifting structure of the global economy, things are not as simple as India taking up China's mantle.

In the 2000s China accounted for nearly a third of global growth—more than America and the European Union combined—adding new productive capacity, each year, equivalent to the present-day output of Austria. By the 2010s China's contribution had roughly doubled, such that each year of expansion was worth an additional Switzerland. From the turn of the millennium to the eve of the pandemic, China grew into the largest consumer of most of the world's major commodities, and its share of global goods exports rose from 4% to 13%.

Could India replicate such feats? It is the world's sixth-largest economy—as China was in 2000. And its output today stands broadly where China's stood two decades ago. China went on to manage an average annual growth rate of about 9%. India grew by just under 7% per year over the same period. It might easily have done better, though, were it not for policy mistakes—such as Prime Minister Narendra Modi's shock decision to withdraw some banknotes in 2016—and macroeconomic vulnerabilities,

including an overextended financial sector. The government may have learnt from the first; both policymakers and the banks have worked to address the second. Before the war in Ukraine the IMF had reckoned that India might grow by 9% this year. Some optimists argue that, in the right circumstances, India could manage such rates on a sustained basis.

A closer look, however, suggests that India is not a substitute for China. One problem is that the world economy is much larger than it used to be, such that a given rise in India's GDP raises global growth by less. Sustained annual growth of 9% would vastly improve the lives of Indians, and meaningfully tilt the balance of global economic and political power. But it would not mean that the world economy would revolve around India, as it did around China over the past two decades. India's contribution to global growth would remain smaller than that of America and Europe combined, for example.

Perhaps more important, global economic conditions may be considerably more forbidding than those that enabled China's rise. From 1995 to 2008, the value of world trade rose from 17% of global GDP to 25%. The share of goods exports participating in global value chains rose from about 44% of world exports to 52%. China was at the forefront of both trends. It was the most dominant trading country since imperial Britain, according to an analysis of "hyperglobalisation" published in 2013 by Arvind Subramanian of Brown University and Martin Kessler of the OECD, a rich-country think-tank.

India, by contrast, is a trade minnow. On the eve of the pandemic it accounted for less than 2% of global merchandise exports. It hopes to raise that share by investing in infrastructure, providing public subsidies to manufacturers and negotiating trade deals with uncharacteristic enthusiasm. But times have changed. World trade has fallen as a share of global GDP since the early 2010s. Economic nationalism could stymie a

recovery. India may nonetheless hope to increase its exports by capturing market share from other economies—including China. But businesses and governments that were once willing to rely heavily on China in the name of efficiency have become more cautious. Their reluctance to become too dependent on any one source of supply could check India's ambitions.

Dominating global supply chains may not be the only route to economic influence. India is a precocious exporter of tech and business services; though its GDP is only one-sixth that of China's, its services exports only just lag behind the latter's. Research published in 2020 by Richard Baldwin of the Graduate Institute in Geneva and Rikard Forslid of Stockholm University argues that technological change is expanding the range of exportable services, and providing more opportunities for workers in poor countries to compete with services workers in the rich world. But while tech and business services may continue to thrive in India, their expansion may be limited by an inadequate system of education, which performs well on measures of enrolment but not of learning outcomes, and by the protected nature of rich-world service sectors, which may be better insulated against foreign competition than were industrial workers against Chinese imports.

| *Subcontinental surge*

Even if India manages a growth rate of nearer 6% than 9%, that would be nothing to sneeze at. It would make India the world's third-largest economy by the mid-2030s, at which point it would contribute more to global GDP each year than Britain, Germany and Japan combined. Indian demand for resources would then drive commodity prices; its capital markets would tantalise foreign investors. A large English-speaking population and a democratic political system, if India can keep it, may allow Indian tech and cultural exports to wield more global influence than did China's at similar income levels.

But the world by then will have recognised, if it has not already, that the rise of China was a unique event. Indian growth will be world-changing. But you should neither hope for, nor fear, a reprise of the Chinese experience. ■



自由交流

世界需要新的经济引擎，印度是否够格？

全球经济结构转变让它难当此重任

世界经济需要多一些希望的曙光。乌克兰战争给全球增长前景带来了沉重一击。抗疫封控和房地产市场低迷让中国这个以往的增长引擎失去了动力。有鉴于印度的体量和潜力，人们似乎自然要问，印度能否成为世界经济的下一个引擎？4月，国际货币基金组织（IMF）估计印度今年的GDP增速可能超过8%——在大型经济体中遥遥领先。这样的快速扩张如果得以持续，将对世界产生深远的影响。但是，事情并不是印度接过中国的衣钵那么简单。这主要是因为世界经济的结构发生了转变。

在本世纪的头十年里，中国贡献了全球经济增长的近三分之一——比美国和欧盟的总和还要多——它每年新增的生产能力相当于现在整个奥地利的产出。到了第二个十年，中国的贡献大约翻了一番，每年的扩张规模相当于增加一个瑞士。从世纪之交到新冠疫情前夕，中国已成为世界上大部分主要大宗商品的最大消费国，占全球商品出口的比重从4%上升到了13%。

印度能否复制这样的壮举？印度现在是世界第六大经济体，与2000年的中国处于同一位置。它今天的产出大致相当于中国二十年前的水平。中国此后保持了年均9%左右的增长速度。印度同期的年增长率略低于7%。不过，如果不是因为一些政策失误——例如总理莫迪在2016年令人震惊地决定收回部分纸币——以及金融部门过度扩张等宏观经济弱点，印度经济完全有可能表现得更好。印度政府可能已经从第一个问题中吸取了教训，而政策制定者和银行都已在努力解决第二个问题。在乌克兰战争爆发前，IMF估计印度经济今年可能增长9%。一些乐观派认为，如果条件合适，印度可以持续实现这样的增速。

然而细究之下就会发现，印度并不能接棒中国。其中一个问题是，世界经济的体量已经远远大于以前，以致一定量的印度GDP增长对全球经济的提升作用变小。保持9%的年增长率将极大地改善印度人民的生活，并显著

影响全球经济和政治力量平衡。但这并不意味着世界经济将围着印度转，就像过去20年围着中国那样。举例来说，印度对全球经济增长的贡献仍将小于欧美的总和。

也许更重要的是，全球经济环境可能比中国崛起时严峻得多。从1995年到2008年，世界贸易额从占全球GDP的17%上升到25%。参与全球价值链的商品出口占全球总出口的比例从44%左右上升到52%。中国走在了这两大趋势的最前沿。布朗大学的阿文德·萨勃拉曼尼亚（Arvind Subramanian）和富裕国家智库经合组织（OECD）的马丁·凯斯勒（Martin Kessler）在2013年发表的一份关于“超全球化”的分析报告认为，中国是自大英帝国以来最具主导地位的贸易国。

相比之下，印度只是一个贸易小国。在新冠疫情前夕，它在全球商品出口中的份额还不到2%。印度希望通过投资基础设施、向制造商提供公共补贴，以及一反常态地积极谈判贸易协议来提高这一份额。但是时代已经变了。自2010年代初以来，世界贸易占全球GDP的比例已经下降。经济民族主义可能会遏制贸易复苏。尽管如此，印度可能还是希望从包括中国在内的其他经济体夺取市场份额来增加出口。但是，曾以效率为名高度依赖中国的各国企业和政府现在已变得更加谨慎。它们不愿意过度依赖任何一个供应源，这可能制约印度的雄心。

主导全球供应链也许并不是扩大经济影响力的唯一途径。在技术和商业服务领域，印度早早成了一个出口大国；尽管它的GDP只有中国的六分之一，但服务出口却只是略低于中国。日内瓦国际关系及发展学院（Graduate Institute）的理查德·鲍德温（Richard Baldwin）和斯德哥尔摩大学的里卡尔德·福斯里德（Rikard Forslid）在2020年发表的一项研究称，技术变革正在扩大可出口服务的范围，并为贫穷国家的工人带来更多与富裕国家服务业工人竞争的机会。然而，尽管印度的科技和商业服务业也许将继续蓬勃发展，其扩张可能会受到教育体系不完善的限制——印度的入学率高，但学习成果不佳。而且富裕国家的服务行业受到保护，相比过去产业工人面对中国进口的冲击，它们可能更能隔绝外国竞争。

| 次大陆崛起

即使印度的增速接近6%而不是9%，也绝对不容小觑。按这个速度，到2030年代中期，它将成为世界第三大经济体，每年对全球GDP的贡献将超过英国、德国和日本的总和。届时印度对资源的需求将推动大宗商品价格；它的资本市场将吸引外国投资者。印度拥有庞大的讲英语人口和民主的政治制度，如果能够保持下去，那么印度的技术和文化出口可能会比中国在同等收入水平时的这类出口发挥更大的全球影响力。

但到那时，世界将认识到（如果现在还没认清的话）中国的崛起是独一无二的事件。印度的发展将改变世界。但你不应该期待，也不必担心，它会重演中国的故事。 ■



India

The Indian economy is being rewired. The opportunity is immense

And so are the stakes

OVER THE past three years India has endured more than its share of bad news and suffering. The pandemic has killed between 2.2m and 9.7m people. Lockdowns caused the economy to shrink temporarily by a quarter and triggered the largest internal migrations since partition in 1947, as city workers fled to their villages. Religious tensions have been simmering, stoked by the anti-Muslim chauvinism of the Bharatiya Janata Party (BJP), in power since 2014 under the strongman prime minister, Narendra Modi. Now a heatwave is baking the north of the country and the global oil- and food-price shock is battering the poor.

Yet if you take a step back, a novel confluence of forces stands to transform India's economy over the next decade, improving the lives of 1.4bn people and changing the balance of power in Asia. Technological leaps, the energy transition and geopolitical shifts are creating new opportunities—and new tools to fix intractable problems. The biggest threat to all this is India's incendiary politics.

Since India opened up in 1991, its economy has prompted both euphoria and despair. One minute it is the next China: a rising superpower bursting with enterprising geniuses. The next it is a demographic time-bomb unable to generate hope for its young people; or a Wild West where Vodafone and other naive multinationals are fleeced. Over the past decade India has outgrown most other big countries, yet this has been overshadowed by a sense of disappointment. It has not engineered the manufacturing surge that enriched East Asia nor built enough big companies to marshal capital for development. Its fragmented markets and informal firms create few good jobs.

As the country emerges from the pandemic, however, a new pattern of growth is visible. It is unlike anything you have seen before. An indigenous tech effort is key. As the cost of technology has dropped, India has rolled out a national “tech stack”: a set of state-sponsored digital services that link ordinary Indians with an electronic identity, payments and tax systems, and bank accounts. The rapid adoption of these platforms is forcing a vast, inefficient, informal cash economy into the 21st century. It has turbocharged the world’s third-largest startup scene after America’s and China’s.

Alongside that, global trends are creating bigger business clusters. The IT-services industry has doubled in size in a decade, helped by the cloud and a worldwide shortage of software workers. Where else can Western firms find half a million new engineers a year? There is a renewable-energy investment spree: India ranks third for solar installations and is pioneering green hydrogen. As firms everywhere reconfigure supply chains to lessen their reliance on China, India’s attractions as a manufacturing location have risen, helped by a \$26bn subsidy scheme. Western governments are keen to forge defence and technology links. India has also found a workaround to redistribute more to ordinary folk who vote but rarely see immediate gains from economic reforms: a direct, real-time, digital welfare system that in 36 months has paid \$200bn to about 950m people.

These changes will not lead to a manufacturing boom as big as those in South Korea or China, which created enough jobs to empty the fields of farmers. They do not solve deep problems such as extreme weather or clogged courts. But they do help explain why India is forecast to be the world’s fastest-growing big economy in 2022 and why it has a chance of holding on to that title for years. Growth generates more wealth to invest in the country’s human capital, particularly hospitals and schools.

Who deserves the credit? Chance has played a big role: India did not create

the Sino-American split or the cloud, but benefits from both. So has the steady accumulation of piecemeal reform over many governments. The digital-identity scheme and new national tax system were dreamed up a decade or more ago.

Mr Modi's government has also got a lot right. It has backed the tech stack and direct welfare, and persevered with the painful task of shrinking the informal economy. It has found pragmatic fixes. Central-government purchases of solar power have kick-started renewables. Financial reforms have made it easier to float young firms and bankrupt bad ones. Mr Modi's electoral prowess provides economic continuity. Even the opposition expects him to be in power well after the election in 2024.

The danger is that over the next decade this dominance hardens into autocracy. One risk is the BJP's abhorrent hostility towards Muslims, which it uses to rally its political base. Companies tend to shrug this off, judging that Mr Modi can keep tensions under control and that capital flight will be limited. Yet violence and deteriorating human rights could lead to stigma that impairs India's access to Western markets. The BJP's desire for religious and linguistic conformity in a huge, diverse country could be destabilising. Were the party to impose Hindi as the national language, secessionist pressures would grow in some wealthy states that pay much of the taxes.

The quality of decision-making could also deteriorate. Prickly and vindictive, the government has co-opted the bureaucracy to bully the press and the courts. A botched decision to abolish bank notes in 2016 showed Mr Modi's impulsive side. A strongman lacking checks and balances can eventually endanger not just democracy, but also the economy: think of President Recep Tayyip Erdogan in Turkey, whose bizarre views on inflation have caused a currency crisis. And, given the BJP's ambivalence towards foreign capital, the campaign for national renewal risks regressing into protectionism. The party loves blank cheques from Silicon Valley but is

wary of foreign firms competing in India. Today's targeted subsidies could degenerate into autarky and cronyism—the tendencies that have long held India back.

| *Seizing the moment*

For India to grow at 7% or 8% for years to come would be momentous. It would lift huge numbers of people out of poverty. It would generate a vast new market and manufacturing base for global business, and it would change the global balance of power by creating a bigger counterweight to China in Asia. Fate, inheritance and pragmatic decisions have created a new opportunity in the next decade. It is India's and Mr Modi's to squander. ■



【首文】印度

印度经济“重新布线”，机会巨大

风险也很高

过去三年里，印度经受了太多的厄运和苦难。新冠疫情致死人数估计在220万至970万之间。封锁令经济一度萎缩了四分之一，并引发了自1947年印巴分治以来规模最大的一次国内人口迁移——城市工人纷纷逃往农村老家。自2014年以来，印度由铁腕总理莫迪领导下的人民党（BJP）执政，在该党反穆斯林沙文主义的煽动下，宗教紧张持续酝酿。目前，印度北部正遭受着热浪的炙烤，全球石油和食品价格的剧烈震荡也给穷人带来了沉重打击。

然而，如果后退一步观察，你将看到一股全新的力量合流势将在未来十年里变革印度经济，改善14亿人的生活，并且改变亚洲的力量平衡。技术飞跃、能源转型和地缘政治变化正给印度带来新机遇——以及解决棘手问题的新方法。而对这一切构成最大威胁的是印度的煽动性政治。

自1991年开放以来，印度的经济让人既欣喜又绝望。一时它是下一个中国：一个崛起的超级大国，到处都是积极进取的天才；一时它是一颗让年轻人看不到希望的人口定时炸弹，或者一片无法无天的狂野西部——沃达丰（Vodafone）等天真的跨国公司在这里被宰。过去十年里印度的经济增速超过了大多数其他大国，然而一种失望感笼罩其上。印度既没有发生让东亚富裕起来的那种制造业繁荣，也没有创建足够多的大公司来为其发展筹集资金。它碎片化的市场和非正规企业创造的好工作少之又少。

然而，随着印度逐渐摆脱新冠疫情，一种新的增长模式开始显现。它有别于以往任何一种模式。一场本地化的技术普及行动是关键。随着技术成本的下降，印度推出了全国性的“技术栈”：一套由政府资助的数字服务，把印度民众与电子身份、支付和税收系统，以及银行账户连接起来。这些平台迅速普及，正在把一个庞大、低效和非正规的现金经济强力推入21世纪。它加速了仅次于美国和中国的世界第三大创业聚集地的发展。

与此同时，全球趋势正在造就更大的商业集群。得益于云技术以及全球软件从业人员短缺，印度IT服务业的规模在十年内翻了一番。试看除了印度，西方公司还能从哪里每年招到50万名新人工程师？可再生能源投资热潮正在兴起：印度不仅是世界第三大太阳能发电国，还是绿色氢能的先驱。随着世界各地的企业开始重新配置供应链以减少对中国的依赖，印度出台的一项260亿美元的补贴计划提升了它作为制造业基地的吸引力。西方各国政府热衷与之建立国防和技术联系。印度也找到了一种变通办法，将更多的财富重新分配给那些有投票权却很少从经济改革中即时获益的普通民众，那就是启用一个直接、实时、数字化的福利系统。该系统在三年内向大约9.5亿人支付了2000亿美元。

这些变化不会带来像在韩国和中国那种规模的制造业繁荣——制造业在这两个国家创造的大量就业机会使得农田乏人耕种。这些变化也不能解决诸如极端天气或官司不断等深层次问题。但它们确实有助于解释为什么印度预计将在2022年成为世界上增长最快的大型经济体，并且有可能在多年内保住这一头衔。经济增长会给印度带来更多财富，用于投资人力资本，特别是医院和学校。

这该归功于谁？很大程度上要归功于机遇：印度不是中美分裂的制造者，也不是云技术的创造者，但它却是中美分裂和云技术的受益者。同样发挥了很大作用的还有许多届政府的零碎改革不断积累。数字身份方案和新的国家税收系统在十年前甚至更早前就已提出构想。

莫迪政府也做对了很多事情。它支持技术栈和直接发放福利，并坚持不懈地把缩减非正规经济这项艰难的工作继续下去。它找到了一些务实的解决办法。中央政府采购太阳能电力带动了可再生能源的发展。金融改革让新公司更容易上市，也让劣质公司更容易倒闭。莫迪在选举上的能力带来了一种经济延续性。就连反对党都预计他将在2024年大选后的很长时间里继续执政。

危险在于这种权势在接下来十年里强化为独裁。一个风险是人民党对穆斯林的敌意，该党用这种可恶的敌意来巩固自己的政治基础。企业往往不怎

么把这当回事，判定莫迪能把这种紧张局面和资本外流都限制在可控水平。但是，暴力和人权状况恶化可能会招致恶名，影响印度进入西方市场。人民党希望在一个庞大而多元化的国家实现宗教和语言的统一，这可能会造成不稳定。如果该党强行将印地语定为“国语”，那么在一些富裕的纳税大邦，分离主义的压力将会上升。

决策的质量也可能恶化。莫迪政府易怒、报复心强，曾指使官僚机构恐吓媒体和法院。2016年推出的拙劣废钞令暴露出莫迪冲动的一面。一个缺乏制衡的强人领袖最终不仅会危及民主政体，也会危及经济：看看土耳其总统埃尔多安就知道了，他对通货膨胀所持的怪诞观点引发了一场货币危机。而且，鉴于人民党对外资的矛盾心态，这场民族复兴运动有可能退化为保护主义。人民党钟爱来自硅谷的空白支票，但对那些在印度的外国竞争对手公司却很提防。现今有针对性的补贴可能会沦为闭关自守和任人唯亲——正是这些倾向长期以来阻碍了印度的发展。

| 抓住时机

印度在未来几年里保持7%或8%的增速将会意义重大。这会让大量人口摆脱贫困。这会为全球商业创造一个巨大的新市场和制造基地，并通过在亚洲建立起一个更大的与中国抗衡的力量，改变全球的力量平衡。国运、政治遗产和务实决策结合在一起，为未来十年创造了一个新机遇。这是印度和莫迪可以挥霍的资本。■



Pop!

Tech bubbles are bursting all over the place

Some more loudly than others

A FAVOURITE PASTIME in Silicon Valley, second only to inventing the next new thing, is bubble-spotting. Even industry insiders tend to get these things spectacularly wrong. “You’ll see some dead unicorns this year,” Bill Gurley, a noted venture capitalist, predicted in 2015, the year that incubation of these startups worth more than \$1bn really got going.

The game has just become much easier: the sound of bubbles popping can be heard all over the place. Tech shares, initial public offerings (IPOs), blank-cheque companies (known as SPACs), startup valuations and even cryptocurrencies: all the assets that climbed to dizzying heights over the past few years are now coming down to earth. It is harder to say how loudly they will burst—and which might still reflate.

The decline of tech shares is the most spectacular. The NDXT, the index of the 100 largest tech firms on the Nasdaq exchange, is down by a third since its peak in early November. Firms in this index have lost a combined \$2.8trn in market value.

High-flying startups that went public in recent years have been hit hard, too. The shares of Robinhood are 80% below the level at which the retail-trading app went public in July 2021. Those of Peloton, which makes internet-connected exercise bikes, have lost over 90% of their value from their peak. As a group, the largest newly listed firms are worth 38% less than at the start of the year (see chart).

Small wonder that IPOs have dried up. From January to April 2021 some 150 companies went public in America, most of them techie. This year only 30

have done so. The boom in SPACs, which go public and then find a startup with which to merge, has imploded. Of the more than 1,000 such firms that have floated in America since 2018, only a third have merged with a target. Many of those that have done deals have lost their shine. According to an index that tracks the 25 largest de-SPACed vehicles, they have lost 56% of their value since the beginning of the year.

As tech shares crash, they are pulling valuations of private firms down with them. CB Insights, a research firm, reckons that tech startups raised \$628bn globally in 2021 in more than 34,000 deals. Between January and March this year the number of transactions fell by 5% compared with the previous quarter. The amount of capital invested dropped by 19%, the biggest quarterly decline since 2012. The unicorn boom's superstar investors have been walloped. On May 12th SoftBank, a Japanese tech investor with a penchant for risky bets, most of which are private, reported that its flagship funds lost an eye-watering \$33bn in the past 12 months.

Although they were meant to reach the Moon no matter what, cryptocurrencies are also coming a cropper. Even some hardened "hodlers" have been getting cold feet. On May 12th bitcoin, the largest cryptocurrency, was trading below \$26,000, less than half its peak in early November. Other digital monies have shed even more value. The next four biggest coins have lost more than 70% since their peak. Non-fungible tokens (NFTs), even more speculative titles to digital assets such as art that can be traded, have been hammered, too. Sales of NFTs in ether, another big cryptocurrency, have dropped by more than half in recent weeks on OpenSea, a big NFT marketplace.

The industry has suffered from an abrupt reversal of fortunes, explains Mark Mahaney of Evercore ISI, an investment bank. In recent years more than one factor gave tech a boost: the coronavirus pandemic pushed life and work online; government stimulus programmes further increased

demand; and super-loose monetary policy made tech's long-term growth more attractive to investors. Now people are turning away from screens and leaving home again; the war in Ukraine is creating paralysing uncertainty; and economies around the world are suffering from inflation and soon, perhaps, recession.

Then there are rising interest rates. Besides possibly triggering a downturn, they reduce the present value of tech companies' profits, most of which lie far in the future. If inflation does not come down, central banks will pile on more rate rises, putting further pressure on risky tech stocks.

How bad will things get? Although stockmarkets have stabilised a bit in recent days, no one is ready to call the bottom. Just as markets have overshot in the past few years, they can undershoot. There is more of a consensus over what could happen when the dust has settled. According to Daniel Ives of Wedbush, another investment bank, the tech industry is at a "fork in the road". As interest rates go up, he argues, investors will turn their back on more speculative growth stocks and focus on the quality names in tech.

No prizes for guessing which ones. Although the combined market value of America's tech titans—Alphabet, Amazon, Apple, Meta and Microsoft—has dropped by nearly 25% since November and their latest results were less stellar than in earlier quarters, they remain safe bets. Together they booked \$359bn in quarterly sales and \$69bn in net profits. Their core businesses are still growing—in particular cloud computing. Collectively, Alphabet, Amazon and Microsoft, the world's three biggest cloud providers, took in \$43bn of sales for such services in the first three months of 2022, up by 33% from a year earlier.

More unexpectedly, older tech and hardware stocks seem in decent nick, Mr Ives notes. Intel, a veteran chipmaker, is down by a relatively modest

13% since November. IBM, a software icon, is up by 12%. Makers of business software with steady sales and high margins, such as Adobe, Oracle and Salesforce, may rebound fast. Hard though it may seem given Coinbase's crash on May 11th, so may payments and crypto platforms, which have joined the financial mainstream. Cyber-security firms, such as CrowdStrike or Palo Alto Networks, could see their fortunes return thanks to fears of Russian and Chinese cyber-attacks. Geopolitical rifts may even lift Palantir, a secretive analytics firm that works with security services, whose share price plunged by 20% on May 9th after it disclosed slowing sales growth.

Persistently unprofitable gig-economy firms look shakier. Uber, the ride-hailing and delivery champion which reported on May 4th that trips and users rose by nearly a fifth year on year in the first quarter, still lost nearly \$6bn. The heavy repricing of video-streamers, with multibillion-dollar content expenses and reversing (Netflix) or even steady (Disney) subscriber growth, may be permanent. The same may be true for second-tier firms in areas such as social media (Snap) or e-commerce (Shopify), which are dominated by Meta and Amazon, respectively.

It would be wrong to compare the current tech slump to the bursting of the dotcom bubble two decades ago. Back then companies had neither healthy balance-sheets nor promising business models. Nowadays many of them have both. The stomach-churning market gyrations are unpleasant to a generation of tech founders, workers and investors who have lived a long bull run. But they are unlikely to stop digital technology eating the world.





啪！

科技泡沫遍地爆裂

有的爆得格外响

除了发明下一个新事物，硅谷最喜欢的消遣就是发现泡沫。即使是业内人士在这类事上也往往会大错特错。“今年会有一些独角兽死翘翘。”著名风险投资家比尔·格利（Bill Gurley）在2015年预测，而这一年这些估值超过10亿美元的创业公司真正开始了一轮大发展。

近来这个游戏变得简单了许多，因为到处都能听到泡沫爆裂的声音。科技股、IPO、空白支票公司（称为SPAC）、创业公司估值，甚至还有加密货币，所有这些在过去几年里涨势令人眼花缭乱的资产现在都在大跌。它们爆得会有多响就更难说了——也难说哪些可能又会膨胀起来。

科技股的跌势最为惊人。纳斯达克100家最大科技公司指数NDXT自去年11月初达到峰值以来下跌了三分之一。该指数中的公司市值总共蒸发了2.8万亿美元。

近年上市的大热的创业公司也遭受了重创。散户交易应用Robinhood的股价比2021年7月公司上市时低了80%。生产联网健身车的Peloton的股价已从峰值跌去了超过90%。最大一批新上市公司的整体市值比年初时下降了38%（见图表）。

IPO会枯竭也就不足为奇了。2021年1月到4月之间，约有150家公司在美国上市，其中大多数是科技公司。今年只有30家。在上市后找一家创业公司与之合并的SPAC曾大行其道，现在已经崩塌。2018年以来在美国上市的1000多家此类公司中，只有三分之一完成与目标公司合并。许多已经完成交易的SPAC已经褪去了光环。一项追踪25项最大SPAC并购交易的指数显示，自今年年初以来它们的市值已缩水56%。

科技股的崩盘也拉低了私有公司的估值。研究公司CB Insights估计，2021

年，科技创业公司在全球通过3.4万多笔交易融资6280亿美元。今年1月至3月，交易数量与上一季度相比下降了5%。投资金额下降了19%，是自2012年以来最大的季度降幅。独角兽热潮中的超级明星投资者元气大伤。5月12日，热衷冒险投注私有公司的日本科技投资公司软银发布财报，它的旗舰基金在过去12个月损失了330亿美元，令人咋舌。

誓要披荆斩棘、勇攀高峰的加密货币也在惨跌。甚至一些坚定的“长期持有者”也开始不淡定了。5月12日，最大的加密货币比特币的交易价格跌破2.6万美元，不到去年11月初时峰值的一半。其他数字货币跌得更多。排在比特币之后的四种最大加密货币的交易价格相比峰值已经下跌了70%以上。非同质化代币（NFT）也受到了重创，它是艺术品等可交易数字资产的权证，投机性更高。最近几周，在大型NFT市场OpenSea上，用以太坊（另一种大型加密货币）交易的NFT的销售额下跌了一半以上。

投资银行Evercore ISI的马克·马哈尼（Mark Mahaney）解释说，行业运势骤然逆转。近年来，不止一个因素推动了科技公司的兴盛：新冠疫情推动了线上生活和工作；政府刺激计划进一步增加了需求；超级宽松的货币政策加大了科技公司的长期增长前景对投资者的吸引力。而现在人们正在远离屏幕，重新走出家门；乌克兰战争产生的不确定性严重干扰了方方面面的运转；世界各地的经济体都在遭受通货膨胀的困扰，而且也许很快又要受衰退之苦。

还有利率上升。除了可能引发经济衰退外，利率上升还降低了科技公司利润的现值，它们的大部分利润都要在遥远的未来才能实现。如果通胀下不来，各国央行将继续加息，给高风险科技股带来更大压力。

事情会变得多糟？尽管近日股市稳定了一点点，但没人认为已经触底。就像在过去几年中市场出现超涨一样，它们也会超跌。对于尘埃落定后会是什么情况，人们的看法更趋一致些。根据另一家投资银行Wedbush的丹尼尔·艾夫斯（Daniel Ives）的说法，科技业正处在“分岔路口”。他认为，随着利率上升，投资者将放弃投机性更强的成长型股票，转而关注科技领域的优质股票。

不用猜都知道这些优质股票是哪几家。尽管Alphabet、亚马逊、苹果、Meta和微软这美国五大科技巨头的合并总市值自去年11月以来已下跌近25%，而且它们的最新业绩也不如前几个季度那么亮眼，但它们仍然是稳妥的赌注。它们的季度销售额和净利润合计分别达到3590亿美元和690亿美元。核心业务仍在增长，尤其是云计算。2022年前三个月，全球三大云供应商Alphabet、亚马逊和微软此类服务的销售额总计430亿美元，同比增长33%。

更出乎意料的是，艾夫斯指出，老牌科技和硬件公司的股票看来表现不错。老牌芯片制造商英特尔自11月以来股价下跌了13%，降幅相对温和。软件行业代表IBM的股价上涨了12%。Adobe、甲骨文、Salesforce等销售稳定、利润率高的商业软件厂商股价可能会快速反弹。已进入金融主流业的支付和加密平台可能也会如此，尽管从Coinbase5月11日的崩盘看似有难度。由于担心俄罗斯和中国的网络攻击，CrowdStrike或Palo Alto Networks之类的网络安全公司的时运可能会有所好转。地缘政治纷争甚至可能提振与安全部门合作的机密分析公司Palantir的股价，在5月9日的财报披露了销售增长放缓之后，该公司股价暴跌了20%。

一直难以盈利的零工经济公司看起来更加不稳定。优步是网约车和外卖领域的佼佼者，它在5月4日发布的财报称一季度出行次数和用户人数同比增长近五分之一，但仍亏损近60亿美元。视频流媒体在内容上的支出以几十亿美元计，订阅用户增幅收小（奈飞）或维稳（迪士尼），市场对这类业务的大幅重新定价可能会是永久性的。社交媒体（Snap）或电子商务（Shopify）领域的二线公司的情况可能同样如此，这两个领域分别由Meta和亚马逊主导。

拿当前的科技股大挫和20年前互联网泡沫的破裂相提并论是错误的。当时的那些公司既没有健康的资产负债表，也没有前途光明的商业模式。如今，很多科技公司两者兼具。市场的强烈动荡让经历了长期牛市的这一代科技公司创始人、员工和投资者感到不适，但不太可能阻挡数字技术一统天下。■



Aerial surveillance

The spy in the sky that sees backwards in time

Use of wide-area motion imagery is spreading

THE WAR in Ukraine has brought the topic of eyes in the sky to general attention, as the Ukrainian army in particular has put surveillance by drone to good effect in identifying and destroying targets in the here and now. But aerial surveillance can also reach backwards in time, by the expedient of indiscriminately recording everything that is going on in a particular neighbourhood, and then looking for useful patterns in the resulting footage. This technique, called wide-area motion imagery (WAMI), has been around since 2006. But improvements in both the recording equipment used and the means by which the images are analysed are making it more and more valuable.

WAMI was first employed by American forces in Iraq to track down those placing roadside bombs. When such a bomb went off, it was possible to run the relevant footage in reverse and trace the events that led up to the explosion. That often allowed the bombers to be identified and dealt with. Clearly, though, the omniscience provided by WAMI can be employed for many other intelligence-related tasks, and the number of jobs the technology is being used for has thus multiplied.

But there is a problem. Explosions are easy to see. For many tasks other than bomber-hunting, however, an awful lot of staring at screens looking for things that are out-of-the-ordinary is involved. People are bad at this—and there is, besides, a lack of willing eyeballs. A study published last year by researchers at the RAND Corporation, a think-tank, showed that America's air force has responded to the flood of data from WAMI sensors by archiving most of it without inspection. Better means of sifting WAMI footage are needed. And technology is starting to provide them.

Chips called graphic-processing units, borrowed from the video-game industry, are helping. So is machine learning, the basis of much modern artificial intelligence. But special tricks are also being deployed—for example, a mathematical technique called higher-order moments anomaly detection that can distinguish moving objects reliably from background clutter by looking at groups of pixels in a video and deciding whether their changes from frame to frame are the result of actual movement or just electronic noise.

Meanwhile, WAMI devices themselves are becoming yet more effective. The latest, announced on April 25th by Transparent Sky, a firm in Albuquerque, New Mexico, promises to take the technology to another dimension. Literally. The video images it shoots are 3D rather than the 2D of a normal WAMI feed.

| *Shoot first. Ask questions afterwards*

WAMI began with an aircraft-borne system called Constant Hawk, which was developed by Lawrence Livermore National Laboratory, in California. Constant Hawk's success in Iraq begat more powerful versions. Gorgon Stare, carried by drone, was designed by the armed forces themselves. A blimp-mounted arrangement called Kestrel, intended to watch over installations such as military bases, emerged from Logos Technologies, a firm that has John Marion, one of Constant Hawk's inventors, as its president. And other countries have joined in, too. Perhaps surprisingly, China is not (as best one can tell) among them. For domestic purposes, at least, it prefers closed-circuit television. But Britain, France, Israel and Turkey all host companies that make WAMI kit.

American firms, however, still rule the roost. L3Harris, a company in Florida, sells WAMI sensors for use as automatic sentries. Their software monitors the coming and going of vehicles and pedestrians into and out of so-called watch boxes. These are protected areas surrounded by virtual trip

wires, the triggering of which will cause a vehicle or individual of interest to be tracked. Motion-analysing software, meanwhile, looks for particular types of driving behaviour, such as avoiding vehicle checkpoints or travelling in convoy.

This approach can detect immediate threats. It can also, working over a longer period, carry out “pattern of life” analysis by building up a picture of what normal daily traffic looks like in an area. That permits the identification of anomalies which might signal hostile agents whose movements would otherwise be masked by the hurly-burly around them.

| *Double WAMI*

The sensors themselves are getting better, too. For one thing, they are smaller. Constant Hawk weighed 680kg. Transparent Sky’s latest weighs in at less than 1kg.

They are also more versatile. Logos, for example, now has “multi-sensor” pods. These combine several types of instrument with WAMI, to increase effectiveness. They are now being tested by America’s navy. The latest version includes a so-called hyperspectral sensor, which sees simultaneously across many different wavelengths, including infrared and ultraviolet. It is thus able to distinguish things which the naked eye cannot, such as the difference between camouflage and vegetation.

This approach’s real power, however, lies in software which automatically passes data between sensors. Mr Marion cites a recent demonstration in which the hyperspectral sensor identified simulated homemade explosive material. That cued an inspection camera to take close-ups. The system then checked the surrounding area for recent vehicle movements, identified a car which had been nearby, and followed it. All of these data were combined into an intelligence package tailored for human consumption. Only at that point was it passed on to a human being.

Future multi-sensor pods may include other instruments, such as signals-intelligence receivers. These are bits of equipment which can detect radio-frequency communicators like mobile phones and walkie-talkies, enabling particular devices to be identified and located. That would permit the individual carrying the phone, and also those he or she came into contact with, to be tracked and photographed. Add specialised infrared cameras and LIDAR, an optical equivalent of radar, and such an instrument would also be able see through dust, haze and darkness.

So far, the costs and complexity of WAMI have kept it as a predominantly military technology. But that is starting to change. Smaller and more affordable versions are now within the reach of police, fire services and other non-military users.

Some such uses are unexceptional. ViDAR (Visual Detection and Ranging), for example, is a system developed by Sentient Vision Systems, an Australian firm, to spot life jackets in search-and-rescue missions. It has a camera that sweeps a wide area and instantly picks out items of interest. Sentient Vision claims it is 300 times faster than a human being at doing so, and can spot a life jacket even in rough seas with six-metre waves. It can also be used to detect illegal fishing.

Such innovation is good if it is used to save lives and catch the bad guys. But at the murky intersection of ordinary crime fighting and sedition it could also offer those inclined to emulate Big Brother a powerful new tool to abuse.

At the moment the employment of WAMI for crime fighting is (as far as is known) still rare. One early example was the use of Simera, a development of Kestrel, to watch an area of 160 square kilometres around the stadia used for the 2016 Olympics, in Rio de Janeiro. That was a temporary expedient, stood down once the games were over. But some police forces in America

have tested WAMI out for day-to-day policing.

The most famous examples were in Baltimore, where the local cops experimented with the idea twice—first in 2016 and then in 2020. The second time around they made the mistake of monitoring a political protest as well as looking for crimes such as vehicle theft. That is precisely the sort of slippery-slope approach which civil-libertarians worry about. They were therefore taken to court by the American Civil Liberties Union. Their actions were ruled unconstitutional and both the police department and the firm involved will have to expunge all records and data collected.

This, and an analysis of the Baltimore experiments by RAND, which suggests they brought only marginal benefit to regular crime fighting, means American police forces will probably not push the point. Nor has a test of WAMI to monitor illegal crossings of America's border with Mexico been followed up. But security services elsewhere, with political as well as crime-fighting agenda, might take a different view. WAMI may yet prove to have legitimate policing uses. But if the price of liberty is eternal vigilance, then vigilance against the misuse of this sort of vigilance needs to be eternal. ■



空中监视

能看到过去的天眼

广域运动图像的应用范围正在扩大

乌克兰战争引发了对“天眼”话题的广泛关注，尤其是当乌克兰军队在使用无人机监视系统实时识别和摧毁目标上取得了很好的效果。但空中监视也可以回溯过去——简单粗暴的做法是把某个区域内发生的所有事情无差别地摄录下来，然后在生成的视频中寻找有用的模式。这种叫作广域运动图像（WAMI）的技术问世于2006年。但随着摄录设备和图像分析方法两方面的改进，它正在变得越来越有价值。

WAMI最初被驻伊拉克美军用于追踪埋设路边炸弹的人。当这类炸弹爆炸时，WAMI可以回放相关的录像，追溯那些导致爆炸的活动。这在很多时候都能识别出炸弹放置者并对他们采取行动。不过显而易见的是，WAMI这种无所不知的能力还可以用到许多其他情报工作上，运用这项技术的工作也因而激增。

但有个问题。爆炸很容易看到。但在除搜寻炸弹埋放者之外的许多任务中，为寻找异常情况需要花大量时间盯着屏幕。人类可不擅长做这项工作——而且也很少有人愿意做。智库兰德公司（RAND Corporation）的研究人员去年发表的一项研究显示，对于WAMI传感器记录的海量数据，美国空军的处理办法是不经检查便把其中的大部分存档。人们需要更好的方法来筛选WAMI录像。现在技术开始派上了用场。

出自电子游戏行业的名为图形处理单元（GPU）的芯片正在发挥作用。同样提供帮助的还有机器学习，它是许多现代人工智能技术的基础。但也用到了一些特别的技术，比如一种叫做高阶矩异常检测的数学方法——通过观察视频中的多组像素，判断它们在帧与帧之间的变化是实际运动的结果还是仅仅是电子噪声，从而可以准确无误地从杂乱的背景中分辨出移动的物体。

与此同时，WAMI设备本身也变得越来越有效力。4月25日，新墨西哥州阿尔伯克基市（Albuquerque）的Transparent Sky公司声称，它最新的WAMI设备有望把这项技术提升到新的维度。这个说法名副其实——它拍摄的视频图像是三维的，而普通WAMI只记录二维图像。

| 先拍，再问

WAMI的前身是一个叫作“恒鹰”（Constant Hawk）的机载系统，由加州的劳伦斯·利弗莫尔国家实验室（Lawrence Livermore National Laboratory）开发。“恒鹰”在伊拉克的成功推动了各种更强大版本的问世。美国军方自行设计了由无人机挂载的“戈尔贡凝视”（Gorgon Stare）。Logos Technologies公司推出了一种安装在飞艇上的叫作“茶隼”（Kestrel）的装置，用来监视军事基地之类的设施，该公司总裁约翰·马里昂（John Marion）是恒鹰的发明者之一。其他国家也纷纷加入。或许出人意料的是，（就已知情况来看）中国不在其中。至少在用于国内目的的监控中，中国更喜欢使用闭路电视。而英国、法国、以色列和土耳其都有生产WAMI设备的公司。

不过美国公司仍然主导着这一领域。佛罗里达州的L3Harris销售可以用作自动化岗哨的WAMI传感器。该公司的软件可以监控进出“岗哨”的车辆和行人。这些所谓的“岗哨”是被虚拟绊线环绕的受保护区域，一旦触发这些绊线，就会导致相关车辆或人员被跟踪。与此同时，运动分析软件会寻找各种异常的驾驶行为，比如避开检查站或结队行驶的车辆。

这种方法可以检测眼下的威胁。也可以对一个区域做较长时间的监控，建立起一幅每日正常的交通状况的图景，从而可以开展“动态模式”分析。这可以识别出可能显示有敌对分子的异常情形，在没有这项技术时其行动会被周围的喧嚣掩盖。

| 双面WAMI

传感器本身也在改进。首先，它们的体积在变小。“恒鹰”重达680公斤。而Transparent Sky最新的传感器重量还不到一公斤。

它们的功能也更多了。例如，Logos公司现在拥有“多传感器”吊舱。这些吊舱把好几种仪器与WAMI组合在一起以提升功效。它们目前正在接受美国海军的测试。最新型号包括一个高光谱传感器，可以同时看到许多不同波长的光线，包括红外线和紫外线。因此它能够识别肉眼无法分辨的东西，比如伪装和植被的差异。

不过，真正厉害的是它的软件能够在传感器之间自动传输数据。马里昂提到最近的一次演示，其中高光谱传感器识别出了模拟的自制爆炸材料。这触发检查摄像机拍下特写画面。然后系统检查了附近区域最新的车辆移动情况，确定了曾在附近出现的一辆汽车，并对它展开跟踪。所有这些数据被整合成一个方便人类查看的情报包。到这一步，这些数据才被传送给某个人员。

未来的多传感器吊舱可能会包括信号情报接收器等其他仪器。这些设备可以探测到手机和对讲机等射频通讯装置，能够识别和定位特定的设备。这样就可以追踪和拍摄该手机的携带者以及他联系的人。这样的设备如果加上专门的红外摄像机和激光雷达（一种光学雷达），还可以穿透灰尘、烟雾和黑暗来持续观察。

因其高成本和复杂性，WAMI一直以来主要是一种军事技术。但这一点开始发生变化。警察、消防和其他非军事用户现在用得着更小、更便宜的版本了。

有些这样的用途平淡无奇。例如，澳大利亚公司Sentient Vision Systems开发的ViDAR（视觉探测和测距）系统用于在搜救任务中发现救生衣。它的摄像头可以扫描广阔的区域，并立即识别出相关物品。该公司声称其速度是人类的300倍，即使在浪高六米的汹涌海水中也能发现救生衣。它还可以用来侦查非法捕鱼。

这样的创新若被用于拯救生命和抓捕坏人是好事一桩。但在普通的打击犯罪和煽动之间的模糊交集地带，它也可能为那些有效仿“老大哥”倾向的人提供一个可被滥用的强大新工具。

目前，部署WAMI来打击犯罪的情况（就目前所知）仍然很少。早期有一例是里约热内卢使用由“茶隼”发展而来的Simera来监视2016年奥运会场馆周围160平方公里的区域。那只是一个临时之举，奥运会一结束它就“退役”了。但是美国的一些警察部门已经测试了把WAMI用于日常治安监控。

最著名的应用案例是在巴尔的摩，当地警方曾两次尝试这个想法——第一次在2016年，之后是在2020年。在第二次尝试中他们犯下了一个错误——不仅用它来查找盗窃车辆等犯罪行为，还用它来监视一次政治抗议活动。这正是主张公民自由的人士所担心的那种滑坡式操作。因此，他们被美国公民自由联盟（American Civil Liberties Union）告上了法庭，最后被裁定违宪，警察局和提供技术的公司都将必须删除所有收集到的记录和数据。

这一结果，加之兰德公司的分析指出巴尔的摩的尝试带给常规打击犯罪的好处微不足道，意味着美国警方很可能不会强推这种做法。一项用WAMI监控非法穿越美墨边境的试验也没有继续推进。但在其他地方，那些既有打击犯罪目标也有政治目标的安全部门可能会持不同的观点。WAMI可能还是会被证明具有合法的警务用途。但是，如果自由要靠无休止的警惕来换取，那么就必须对滥用这种警惕保持无休止的警惕。■



The Economist Film

Sustainable materials: A concrete solution? (Part 1)

The five billion tons of cement produced each year account for 8% of man-made CO₂ emissions.



经济学人视频

绿色建材：混凝土减排（上）

全球每年生产的50亿吨水泥造成了8%的人为二氧化碳排放。



Combating diseases

Bill Gates explains “How to Prevent the Next Pandemic”

His proposals for nipping infections in the bud are worth exploring

How to Prevent the Next Pandemic. By Bill Gates. Knopf; 304 pages; \$28. Allen Lane; £25

FIRST, THE climate. Next, plagues. Bill Gates’s career-switch from entrepreneur and philanthropist to crusading author is developing nicely. It is just over a year since he published “How to Avoid a Climate Disaster”. Now he sets out to explain “How to Prevent the Next Pandemic”.

Both books consider what might be described as human-created natural disasters. Some disasters—hurricanes, earthquakes, tsunamis—are purely natural. The best people can do when dealing with these is to anticipate them through things like warning systems, planning codes and reinforced buildings. Others, such as war, have human causes. They may sometimes have a natural trigger, such as a drought that sets populations on the move. But human beings inflict the damage.

Climate change and epidemics are halfway between these extremes. They are caused by people interacting with nature—in one case by altering the atmosphere’s chemical make-up, in the other through actions ranging from inadequate disposal of sewage to international jet travel and sexual activity. As Larry Brilliant, one of the epidemiologists who helped to eradicate smallpox, observes, “Outbreaks are inevitable [the nature part of the equation] but pandemics are optional [the human part].” And that provides an opening for the sort of techno-optimistic approach that Mr Gates loves.

One pandemic that might have been optional had it been spotted early enough— AIDS—has been in his cross-hairs for years, as part of the activity

of the foundation he runs jointly with his ex-wife Melinda French Gates. AIDS has killed some 36m people, most of them since it came to the attention of medical science in 1981. Yet subsequent analysis has shown it had been spreading in Africa for decades. A better early-warning system could have picked it up in the 1950s, rather than the 1980s, allowing it to be tackled much earlier.

Sexually transmitted infections, though, spread slowly. Airborne ones spread fast—particularly in an era of mass international travel. Early detection is vital, and is the first item on Mr Gates’s list of things to accomplish. Others include helping people protect themselves; finding new treatments; and developing vaccines. And practice drills: he is big on the idea that, just as military forces drill and earthquake-response teams drill, so should those tasked with combating pandemics.

But who should those people be? That is the nub of the book. Armed forces and civil-defence teams are national responsibilities. But pathogens know no borders, and governments, in any case, are curiously uninterested in contingency planning for new diseases. While covid-19 remains fresh in people’s minds, Mr Gates sees an opportunity to correct this.

He suggests creating a global “fire brigade” of 3,000 experts scattered around the world, recruited for skills ranging from epidemiology and genetics, through drug and vaccine development and computer modelling, to diplomacy. This outfit, which would probably work under the auspices of the World Health Organisation, would remain on permanent standby, ready to respond to any detected outbreak.

Mr Gates tentatively proposes that it be called GERM (Global Epidemic Response and Mobilisation). The PR department might not like the name, but the idea is worth exploring. He estimates GERM itself would cost about \$1bn a year. While waiting for the call, its staff would be employed in

beefing up the world's anti-pandemic infrastructure—this is where the diplomacy would come in—by chivvying governments into the necessary spending on detecting, monitoring and suppressing potential outbreaks. And in running drills.

On the technological side, his shopping list includes designing and agreeing on protocols for the rapid mass-testing of drugs that might work against a particular pathogen if an outbreak did happen. (Britain's RECOVERY trial, which was ready to go within six weeks of covid-19 being identified, and eventually included 40,000 participants at 185 sites, comes in for particular praise here.) Mr Gates also wants to improve both vaccine manufacturing and distribution, and to improve vaccines themselves, particularly by eliminating cold chains.

Most existing vaccines are temperature-sensitive, and must be passed quickly from one refrigerator to another en route to the clinics where they will be used. Mr Gates recommends research into the development of heat-tolerant vaccines. For pathogens that spread through the air, he favours a cutting-edge approach to prevention: nasal sprays containing drugs that bind to the cell-surface proteins which viruses use to gain entry, thus denying them the means to get into their target cells.

And he envisages new, broad-spectrum jabs against entire classes of viruses, such as influenza. Techno-optimist that he is, he suggests such universal vaccines could not only pre-empt illnesses of the future, but annihilate those of the present. In other words, no more flu. Ever.

That does sound pretty optimistic, especially given the difficulty of eliminating even single viruses from the planet—something that has been achieved only for smallpox and for a cattle disease called rinderpest, and has notably not happened for polio, which still lingers in a few places despite a decades-long campaign to get rid of it. But, as Arthur C. Clarke put

it in his second law of science, “The only way of discovering the limits of the possible is to venture past them into the impossible.”

Whether anything like GERM will ever come to pass, as the world’s attention shifts from the crisis of covid-19 to the catastrophe in Ukraine, remains to be seen. But if this book stimulates even a little limit-pushing of the sort Mr Gates suggests, it will have served its purpose well. ■



对抗疾病

比尔·盖茨阐述“如何预防下一场大流行病”

他关于把感染扼杀在萌芽状态的提议值得探索【《如何预防下一场大流行病》书评】

《如何预防下一场大流行病》。比尔·盖茨著。克诺夫出版社；304页；28美元。艾伦莱恩出版社；25英镑。

先是气候。再是瘟疫。比尔·盖茨从企业家、慈善家，到笔耕不辍的作家的职业赛道转换流畅自如。他的《如何避免气候灾难》（How to Avoid a Climate Disaster）上架刚过一年，他又开始讲解“如何预防下一场大流行病”。

两本书都探索了或许可被称为“人为自然灾害”的事件。有些灾难——比如飓风、地震、海啸——是纯自然事件。在对付它们时，人能做的最好的事就是通过警报系统、规划规范和建筑物加固等方式来做好准备。其他的灾难，比如战争，是人为的。它们有时也可能有自然触发因素，比如迫使人口迁移的旱灾。但造成损害的是人类。

气候变化和流行病介于这两个极端之间。它们是由人类与自然的互动导致的——前者是通过改变大气的化学构成，后者是通过不当污水处理、国际航班和性行为等各类活动。正如帮助根除了天花的流行病学家之一拉里·布莱恩特（Larry Brilliant）所说，“局部爆发[即自然的因素]不可避免，但全球大流行[人的因素]并非必然。”这就为盖茨热爱的那种技术乐观派应对方式提供了机会。

一种本可能通过及早发现来避免的大流行病是艾滋病。盖茨聚焦艾滋病已有多多年，这是他和前妻梅琳达·盖茨共同经营的基金会活动的一部分。艾滋病已导致约3600万人死亡，其中大多数发生在它于1981年进入医学界的视野之后。但随后的分析表明，它此前已经在非洲蔓延了好几十年。一个更好的预警系统本可在1950年代而不是1980年代发现它，从而可以提前很多年来应对。

不过，性传染疾病的传播速度慢。空气传染疾病的传播速度快——尤其是在一个大规模国际旅行的时代。及早发现至关重要，这是盖茨要实现的事项清单上的第一项。其他还包括帮助人们自我保护、找到新疗法，以及研发疫苗。还有演习。他坚信，就像军队要演习，地震救援小组要演习那样，负责抗击流行病的人也该演习。

但那些人该是谁呢？这就是本书的重点了。武装部队和民防队是国家责任。但病原体没有国界，而且各国政府也都对新疾病应急计划出奇地不感兴趣。趁着人们对新冠肺炎记忆犹新，盖茨看到了纠正这件事的机会。

他建议创建一支由分布在世界各地的3000名专家组成的全球“消防队”，招募的技能涵盖流行病学和遗传学、药物和疫苗开发、计算机建模，以及外交等。这个很可能受世卫组织支持的部队将保持永久待命状态，随时准备应对任何探测到的局部疫情。

盖茨暂时提议把这支队伍取名GERM（“全球流行病响应与动员”的缩写）。公关部门可能不喜欢这个名字，但这个想法值得探索。他估计GERM本身每年将花费约十亿美元。在待命的同时，队员们将敦促政府投入必要的支出来发现、监控和扑灭潜在疫情，以此加强全球抗流行病基础设施——这里就要用到外交了。此外还要组织演习。

在技术方面，他的购物单包括设计和议定有关迅速开展大规模测试药物的协议，以求找出在确有局部爆发时对特定病原体有效的药物。（书中尤其赞扬了英国的“康复”试验 [RECOVERY] 在新冠肺炎被确定后的六周内就已启动，最后在全球185个地点招募了四万人。）盖茨还想改善疫苗的制造和分销，以及改进疫苗本身，特别是要拿掉冷链。

大多数现有疫苗都对温度敏感，在送往将要使用它们的诊所的途中必须从一个冰箱快速转至另一个。盖茨建议研发耐热疫苗。对于通过空气传播的病原体，他倾向于采用尖端的预防方法：鼻腔喷雾剂内含有的药物会和病毒用来入侵的细胞表面蛋白结合，从而使病毒无从进入这些靶细胞。

他还构想了防御一整类病毒（比如流感病毒）的新型广谱疫苗。这位技术

乐观主义者认为这种通用疫苗不仅可以先发制人避免未来的疾病，也能消灭当前的。换言之，世上再无流感。永远不再有。

这听起来确实相当乐观，尤其是考虑到要从地球上消灭哪怕一种病毒都困难重重——仅仅在天花和一种叫牛瘟的牛的疾病上成功过；而最显著的失败案例是小儿麻痹症，尽管人们为除掉它努力了几十年，它仍在一些地方挥之不去。但是，正如亚瑟·克拉克（Arthur C. Clarke）的第二科学定律所言，“发现可能性之极限的唯一方法就是越过它们，进入不可能的领域。”

随着世界的注意力从新冠危机转移到乌克兰的灾难，像GERM这样的事物是否会成真还需拭目以待。但是，如果这本书能够激发出即便一点点盖茨建议的那类突破，那就很成功了。■



Alibaba and the 40 officials

Can Chinese big tech learn to love Big Brother?

The government's crackdown eases, but the damage has been done

JACK MA, CHINA'S most famous entrepreneur, has not been one to mince his words about the role of government and business. At a meeting with corporate leaders in Bali in 2018 he told the audience that it is not the government that makes business and innovation happen. That is the work of entrepreneurs, he insisted: "They have the ideas and dreams."

A crackdown that began in late 2020 on China's consumer-internet champions has made such inspiring sentiments harder to sustain. For the first time the leading firms' sales growth is slowing. Alibaba's revenues rose by just 10% in the final three months of 2021, the slowest quarterly expansion since going public in 2014. Tencent, an internet-services and video-game Goliath, notched up 8% revenue growth in the same period, its slowest rate as a public company (see chart 1). JD.com, another e-commerce group, announced solid revenues but Richard Liu, its founder and chairman, resigned in April, one of many high-profile entrepreneurs to do so in the past few years. Local media reported that Meituan, a delivery giant, plans to axe up to 20% of its employees in its core business units despite its sales rising by 30%. Shares in those four companies, along with Pinduoduo, one more e-commerce group, have shed about \$1.5trn in value since February last year (see chart 2).

The techlash is moving into a new phase. The sorry state of the Chinese economy has forced regulators to delay further planned corporate punishment in the hope that the industry can help recharge growth. In the most positive signal for tech in over a year, the central government said on April 29th that it planned to normalise regulation and to "promote the healthy development of the platform economy". The share prices of several

firms, including Alibaba, soared at the news. But some new rules have been merely put off rather than withdrawn, according to the Wall Street Journal. And much damage has already been done. The entrepreneurs behind China's biggest tech successes have come to a grim reckoning: that because of government meddling they will be unable to innovate, and may even become boring.

When Mr Ma celebrated Chinese enterprise in Bali, Alibaba and Tencent were two of China's biggest private investors, pushing into an array of businesses. Acquisitions were giving them an early toehold in hot new areas. Online education and health, media and entertainment, banking and lending services: all were fair game. By 2020 Ant, Alibaba's financial affiliate, had swallowed up 15%, or 1.7trn yuan (\$257bn), of the market for total outstanding consumer loans in China. As Jeff Bezos, founder of Amazon, was buying the Washington Post, and Jack Dorsey of Twitter, a social-media group, was launching Block, a payments platform, Mr Ma was scooping up his own media assets and building a finance conglomerate.

American tech bosses are still reshaping and expanding their empires. Mark Zuckerberg, founder of Facebook, is seeking to turn his social-media group into a "metaverse company", bringing virtual reality to the mainstream. Elon Musk, boss of Tesla, an electric-car maker, is buying Twitter. Chinese empire-builders, by contrast, are tempering their ambitions.

Beijing's regulatory crackdown has greatly discouraged risk-taking. Tencent's foray into online education in 2019 is now a dead end, as is that whole industry, after sweeping new rules were enacted last year on the services that can be offered to school-age pupils. Investors want nothing to do with Chinese fintech after Ant's initial public offering was crushed by Communist Party leaders in late 2020. Forget about massive data-crunching businesses, too, where the government's new framework for

control and ownership of personal and financial data will limit private innovation. Online video-games, Tencent's chief revenue-generator, have also come under attack. The government has signalled it will no longer tolerate private investment in news-gathering, putting Mr Ma's media empire at risk. It may even be planning to take small stakes in tech firms in order to guide their development.

The companies' strategies reflect limited options for rapid growth. Take Alibaba and its three core areas of operation: international, such as Lazada, an e-commerce business based in Singapore; within China, dominated by e-commerce; and a tech division that counts cloud computing as its biggest engine of growth.

Alibaba's solution to a long-expected slowdown in Chinese e-commerce as the market becomes saturated has been to move into smaller, poorer cities across the country with the expansion of Taobao Deals, a platform that allows groups of people to buy products at lower cost. The company has recently started playing down this strategy to analysts and investors, who are underwhelmed by its low margins.

Its global business has grown rapidly, mainly thanks to the fast expansion of Lazada. But its retail operations abroad have contributed only about 5% of overall annual revenues since 2017, and are unlikely ever to make up a meaningful part of the Alibaba empire. Its prospects of breaking into developed markets in America and Europe are close to non-existent. Some of that pessimism is based on America's increasing distrust of Chinese companies. In 2018 Ant's attempt to buy an American payments firm was shot down by regulators in Washington on national-security grounds. This has prompted Alibaba to focus more on developing markets with much less spending power.

Chinese regulators, too, have clamped down on the tech titans' foreign

investments. They have also stepped up prevention of monopolistic behaviour at home, stifling domestic investments. Alibaba was one of China's biggest corporate acquirers in 2018, when it pulled off about \$18bn in mergers and acquisitions. In 2021 that slumped to \$5.7bn, over four-fifths of which was spent within China, according to Refinitiv, a data company. The more acquisitive Tencent's dealmaking was valued at \$20bn last year, down from \$32bn in 2018; the company also sold about \$16bn in shares in JD.com in December, sparking fears that regulators were pushing it to unwind its sprawling empire.

As customary sources of revenue come under further pressure, China's internet giants have gamely talked up a new stage of innovation—one in which their ambitions are defined by the state. The government wants Chinese big tech to make or design semiconductors and artificial-intelligence (AI) software, and run cloud-computing businesses. It has been designating specific areas for companies to pursue, giving a green light for private entrepreneurs to go after the next big thing, as long as it lines up with policy goals. Baidu, best known as China's online-search champion, is the government's first choice for leading AI and autonomous-driving businesses. On April 28th the firm was awarded China's first permit for driverless ride-hailing on public roads.

Many tech firms have taken the hint. Alibaba relies heavily on the success of its cloud-computing division, which leads the market and brought in 8% of total revenue in the last quarter of 2021. In February Daniel Zhang, Alibaba's chief executive, told analysts that cloud computing could be a trillion-yuan business by 2025 and be transformed into his firm's main activity. Tencent and Baidu have large and growing cloud operations, too. Most business-to-business services will one day be dominated by the incumbent tech groups, says Elinor Leung of CLSA, an investment bank.

Such top-down delegation of entrepreneurial activity cannot be completely

written off, says David Hsu of the Wharton School in Pennsylvania. State-backed research and development is commonplace in even the most market-driven economies. The momentum building in China may eventually enhance the underlying technologies on which a new wave of enterprise will take root.

| *Bottling up the genie*

Finding state-endorsed technologies to invest in is politically expedient for the largest internet platforms, says Robin Zhu of Bernstein, a broker. Robin Li, Baidu's founder, has embraced his firm's party-picked mission with such zeal that he even wrote a book on autonomous driving last year. Yet even self-driving cars and other state-backed projects will probably fall short of the growth rates to which the companies became accustomed in the heady 2010s.

Alibaba is again a case in point. Aliyun, its party-approved cloud business, has suffered big setbacks recently. It lost ByteDance, the owner of TikTok, Western teenagers' favourite time sink, as a customer. A steady stream of state-controlled companies are leaving it for cloud platforms owned by other state groups. China's big telecoms firms, which have competing businesses, are expected to eat up market share in the lower-value-added part of cloud services. There are limits to how much Aliyun can earn in foreign markets, where a distrust of Chinese technology has led to the banishment of tech compatriots such as Huawei, a telecoms-equipment maker. Aliyun's revenues grew by 20% year on year in the last quarter of 2021. Not bad, you might think. But much slower than analysts had anticipated. ■



阿里巴巴和四十大官

中国的科技巨头能学会爱老大哥吗？

政府的打压有所缓解，但损害已经造成

中国最著名的企业家马云在谈到政府和企业的角色时从来直言不讳。2018年在巴厘岛举行的一个企业领袖会议上，他对听众说，令商业和创新发生的不是政府。那是企业家的的工作，他坚称，“他们有创意和梦想。”

中国消费互联网领军企业从2020年底开始受到打压，让这种激励人心的观点更难立足。这些头部公司的销售增长首次出现放缓。在2021年最后三个月里，阿里巴巴的收入仅增长10%，是该公司2014年上市以来最慢的季度增长。互联网服务和游戏巨头腾讯同期收入增长8%，同样是公司上市以来的最小增幅（见图表1）。另一家电子商务集团京东公布的收入增长稳健，但其创始人兼董事局主席刘强东于4月辞任CEO一职，是过去几年里一大批辞职的知名企业家之一。当地媒体报道称，尽管销售额增长30%，外卖巨头美团仍计划在其核心业务部门裁员20%。去年2月以来，这四家公司以及另一家电子商务集团拼多多的市值已缩水约1.5万亿美元（见图表2）。

对科技公司的打压正在进入一个新阶段。中国经济的糟糕现状迫使监管机构推迟原计划中更多惩罚企业的行动，希望该行业能够推动经济恢复增长。4月29日，中央政府表示计划实施常态化监管，“促进平台经济健康发展”，这是一年多来对科技企业发出的最积极的信号。包括阿里巴巴在内的几家科技公司的股价应声大涨。但据《华尔街日报》报道，一些新规定只是推迟执行，并非撤回。而且很大的损害已经造成。中国最成功的科技企业背后的企业家们已经得出了一个严峻的结论：由于政府的干预，他们将无法创新，甚至可能变得死气沉沉。

马云在巴厘岛赞美中国企业之时，阿里巴巴和腾讯是中国其中两家最大的私人投资机构，正在打入一系列业务领域。通过收购，它们在热门新领域早早获得了立足点。从在线教育和健康、媒体和娱乐，到银行和贷款服

务，通通都是可以出手的目标。到2020年，阿里巴巴旗下的金融公司蚂蚁集团已经占到了中国未偿消费贷款总额的15%，规模达到1.7万亿元。当亚马逊的创始人杰夫·贝索斯在收购《华盛顿邮报》，社交媒体集团推特的杰克·多尔西（Jack Dorsey）在推出支付平台Block时，马云也在累积自己的媒体资产并打造一个金融集团。

美国的科技大佬仍在重塑和扩张他们的帝国。Facebook创始人扎克伯格正力图将他的社交媒体集团变成一家“元宇宙公司”，将虚拟现实带入主流。电动汽车制造商特斯拉的老板马斯克正在收购推特。相比之下，中国的帝国建造者们正在收敛野心。

北京的监管打压极大地抑制了商业冒险。腾讯在2019年进军在线教育，而中国去年开始就义务教育阶段学生的校外培训推出扫荡式新规，让腾讯的扩张和整个在线教育行业都陷入绝境。蚂蚁集团2020年底的上市被共产党领导人压制，在那之后投资者就再不想和中国的金融科技行业扯上任何关系。也不用惦记大规模数据处理业务了，中国政府有关个人和财务数据控制及所有权的新政策框架将限制私人创新。网络游戏这一腾讯的主要收入来源也受到了打击。政府已示意将不再容许私人投资新闻采编，这将马云的媒体帝国置于险境。政府甚至可能计划少量入股科技公司，以指导它们的发展。

这些公司的战略反映出实现快速增长的选择有限。来看看阿里巴巴和它的三块核心业务：国际业务，比如总部位于新加坡的电子商务企业Lazada；以电子商务为主导的国内业务；以及依靠云计算为最大增长引擎的科技业务。

随着市场趋于饱和，早有预期中国电子商务的发展将放缓，阿里巴巴此前的应对方法是通过低价团购平台淘特的扩张进入国内那些收入更低的小城市。最近阿里巴巴开始向分析师和投资者淡化这一战略，因为他们对淘特的低利润率感到索然无味。

阿里巴巴的国际业务增长迅速，这主要源于Lazada的快速扩张。但2017年

以来，它的海外零售业务对年收入的贡献仅有5%左右，而且不太可能成为阿里巴巴帝国重要版图的那一天。它打入欧美发达市场的可能性几乎为零。这种悲观情绪一定程度上源于美国日益不信任中国企业。2018年，当时的蚂蚁金服想要收购一家美国支付公司，被华盛顿的监管机构以国家安全为由驳回。这促使阿里巴巴把重心更多地转向消费能力低得多的发展中市场。

中国的监管机构也在打压本国科技巨头的海外投资。它们还加强防范国内垄断行为，这抑制了国内投资。2018年，阿里巴巴是中国最大的收购者之一，当年完成了约180亿美元的并购交易。数据公司路孚特的数据显示，这一数字在2021年暴跌至57亿美元，其中超过五分之四用在了中国境内。更热衷于收购的腾讯去年的并购交易额为200亿美元，而2018年为320亿美元。去年12月，腾讯还出售了价值约160亿美元的京东股票，引发了人们担忧监管部门正在施压它拆解庞大帝国。

随着惯常收入来源进一步受压，中国的互联网巨头开始英勇地大谈新的创新阶段，在这个阶段它们的雄心壮志由国家来定义。政府希望中国的科技巨头生产或设计半导体和人工智能软件，以及经营云计算业务。它一直在为这些公司指定发展方向，为民营企业追求“下一个大事件”开绿灯——只要它是符合政策目标的。中国在线搜索龙头企业百度就被政府选中来引领人工智能和自动驾驶的发展。4月28日，百度获得了中国首批公开道路无人化自动驾驶出行服务许可。

许多科技公司已经领会了政府精神。阿里巴巴现在非常仰仗其云计算部门的成功，该部门在市场上居于领先地位，在2021年最后一个季度贡献了公司总收入的8%。2月，阿里巴巴首席执行官张勇向分析师表示，到2025年云计算的市场规模可能会达到万亿元级别，转变为该公司的主要业务。腾讯和百度也拥有庞大且不断增长的云业务。投资银行里昂证券的梁向奕表示，有朝一日，大多数B2B服务都将由现有的科技集团主导。

这种自上而下的委派式创业活动不能被完全否定，宾夕法尼亚州沃顿商学院的许大卫说。即使在市场化程度最高的经济体中，政府支持的研发也很

普遍。中国的这种发展势头最终可能会增强底层技术，让新一批企业在上面扎根发芽。

| 关注妖怪

经纪公司盛博的朱镛表示，对于那些最大的互联网平台来说，找国家认可的技术来投资是政治上的权宜之计。百度创始人李彦宏非常积极地拥抱了党为公司挑选的使命，甚至在去年写了一本关于无人驾驶的书。然而，即使是无人驾驶汽车和其他政府支持的项目可能也不足以再现这些公司在2010年代习以为常的那种强劲增长。

在这一点上阿里巴巴又是一个很好的例子。受党认可的云业务阿里云近来大受挫折。它丢失了字节跳动这个大客户，这家公司旗下的TikTok是西方青少年钟爱的消遣工具。源源不断的国有企业正弃阿里云而去，转投其他国有集团拥有的云平台。与阿里云竞争的中国大型电信公司预计将分走云服务中附加值较低的那部分市场份额。阿里云能在国外市场斩获的收入有限，那里对中国技术的不信任已经导致电信设备制造商华为等中国科技公司被驱逐。阿里云的收入在2021年最后一个季度同比增长了20%。你可能觉得还不错。但这增速比分析师的预期慢多了。■



Ottomanpower

Turkish builders are thriving in Africa

And giving Chinese competitors a run for their money

SELIM BORA has had quite a run. In March his company, Summa, won a contract to rebuild and run Guinea Bissau's new international airport. Months earlier it had completed a 50,000-seat national stadium in Senegal, after less than 18 months of work—a sprint-like pace for such projects. The company's résumé also includes convention centres in the Democratic Republic of Congo and Equatorial Guinea, a sports arena in Rwanda, and airports in Niger, Senegal and Sierra Leone. “Ten years ago we had no projects in Africa outside of Libya,” recalls Mr Bora, taking in the view from his office in Istanbul. “Today 99% of our work is in Africa.”

Turkey's construction industry is an international heavyweight. Of the world's 250 biggest contractors, 40 are Turkish, behind only China and America. Many have long had a big footprint in north Africa. Of late they have begun making inroads in the continent's south. Last year alone the value of projects undertaken by Turkish builders in sub-Saharan Africa was \$5bn, or 17% of all Turkish building projects abroad, up from a paltry 0.3% before 2008. The region has overtaken Europe (10%) and the Middle East (13%), and is second only to countries of the former Soviet Union. In parts of Africa Turks are even giving Chinese builders, which continue to dominate construction in Africa, a run for their money.

Many of the Turkish construction firms got their African start in Libya in the 2000s, where they locked up billions of dollars in contracts. The toppling of the country's dictator, Muammar Qaddafi, in 2011 and the ensuing civil war forced them to flee. They found new opportunities south of the Sahara, where their reputation regularly preceded them: many African leaders who had visited Libya and admired Turkish projects there

were eager to work with the companies responsible for them.

Some assistance for Turkish projects comes from Turkey's export-credit bank and public lenders from Japan. Both countries are, for their own strategic reasons, keen to check Chinese interests in Africa. Still, the Turks concede that they can rarely compete with Chinese rivals on price. "We cannot match the Chinese, because they come in with their own financing and we have to go to the markets," says Basar Arioglu, chairman of Yapi Merkezi, another big construction firm.

The Turkish firms are therefore stressing other selling points instead. They tend to work faster than Chinese rivals and to offer superior quality. Having completed a big railway project in Ethiopia a few years ago, Yapi Merkezi more recently beat Chinese rivals to build the first section of a Tanzanian railway connecting Dar es Salaam and Lake Victoria. In December it signed a \$1.9bn deal to build the third section.

The Turks are also happy to comply with African governments' demands to hire local subcontractors and workers, which the Chinese have been more reluctant to do. This is in large part making a virtue out of necessity: whereas Chinese firms can afford to bring their own skilled workers, including engineers, to Africa, Turkish ones often cannot. Since Turkey lacks China's resources to be in all places at once, Mr Arioglu observes, "the only way we can survive in the long run is to become local in all the countries we work in." When Summa began working in Senegal in the 2010s, its workforce was 70% Turkish, remembers Mr Bora. That figure is now down to 30%.

Some Africans still grouse about the Turkish presence in their countries. Like the Chinese, "they come and go," grumbles one official, creating only fleeting jobs. Another complains that the Turks (and other newcomers) invest in construction, mining and ports rather than higher up the value

chain, which would do more for Africa's broader economic development. And they could launch more joint ventures with African companies.

Such gripes are, however, outweighed by one last consideration increasingly prized by African governments. "We came at a lucky time," recalls Mr Arioglu, "when both Ethiopia and Tanzania were looking for alternatives to Chinese companies." As more sub-Saharan countries follow suit, being non-Chinese is a Turkish trait that China's builders cannot match. ■



奥斯曼力量

土耳其建筑商在非洲发展壮大

也成为中国公司的强劲对手

塞利姆·博拉（Selim Bora）正春风得意。今年3月，他的公司Summa赢得了重建和运营几内亚比绍新国际机场的合同。几个月前，它还在塞内加尔建成了一座能容纳五万人的国家体育场，仅用了不到18个月——对这类项目来说可算是冲刺了。该公司的履历表上还有刚果民主共和国和赤道几内亚的会议中心、卢旺达的一个体育场馆，以及尼日尔、塞内加尔和塞拉利昂的机场。“10年前，除了利比亚，我们在非洲什么项目也没有，”博拉在他伊斯坦布尔的办公室里一边欣赏风景一边回忆说，“现在，我们99%的业务都在非洲。”

土耳其的建筑业在国际上举足轻重。世界上最大的250家承包商中有40家来自土耳其，仅次于中国和美国。许多公司在北非一直都有着广泛的业务。近来它们开始进军非洲大陆的南部。仅去年一年，土耳其建筑商在撒哈拉以南非洲承接的项目就价值50亿美元，占土耳其所有海外建筑项目的17%，而2008年之前这个比例只有区区0.3%。这一地区的占比已经超过了欧洲（10%）和中东（13%），仅次于前苏联国家。在非洲的部分地区，土耳其人甚至对继续主导非洲建筑业的中国建筑商构成挑战。

许多土耳其建筑公司在非洲的起步都始于本世纪头十年的利比亚，它们在那里锁定了数十亿美元的合同。2011年利比亚独裁者卡扎菲的倒台以及随之而来的内战让它们被迫逃离。它们在撒哈拉以南找到了新的机会，在那里它们往往早已声名远播：许多非洲领导人曾访问利比亚，欣赏过土耳其在那里的项目，他们渴望与负责这些项目的公司合作。

一些对土耳其项目的援助来自土耳其的出口信贷银行和日本的公共贷款机构。出于各自的战略原因，这两个国家都热衷于遏制中国在非洲的利益。不过，土耳其人承认，他们在价格上很少能和中国对手竞争。“我们没法跟中国公司比，因为它们有自己的资金来源，而我们得找市场融资。”另

一家大型建筑公司Yapi Merkezi的董事长巴萨尔·阿里奥格鲁（Basar Arioglu）说。

因此土耳其公司转而强调其他卖点。它们往往比中国竞争对手的施工速度更快，而且质量上乘。几年前Yapi Merkezi在埃塞俄比亚完成了一个大型铁路项目，后来它击败中国竞争对手，修建了连接达累斯萨拉姆（Dar es Salaam）和维多利亚湖（Lake Victoria）的坦桑尼亚铁路的第一段。去年12月，它签署了一项19亿美元的协议，将建设该铁路的第三段。

土耳其人也乐于满足非洲政府雇用本地分包商和工人的要求，而中国公司则不太愿意这么做。前者在很大程度上是不得已而为之：中国公司负担得起把自己的技术工人（包括工程师）带到非洲，而土耳其公司往往不能。既然土耳其缺乏中国那种可以遍地开花的资源，阿里奥格鲁认为，“我们要长期生存下去，唯一的办法就是在我们工作的所有国家都实现本地化。”当2010年代Summa开始在塞内加尔施工时，有70%的员工是土耳其人，博拉回忆说。现在这个数字下降到了30%。

一些非洲人仍在抱怨土耳其人在自己国家的存在。跟中国人一样，“他们来了又走”，一位官员抱怨道，创造的工作机会转瞬即逝。另一位官员抱怨说，土耳其人（还有其他新来者）投资于建筑、采矿和港口，而不是价值链的更上端，后者更能促进非洲更广泛的经济的发展。而且它们本可以和非洲公司联手成立更多合资公司。

不过，这类怨言被最后一项考量盖过，那是非洲各国政府都越来越重视的一点。“我们过来的时机很幸运，”阿里奥格鲁回忆说，“那会儿埃塞俄比亚和坦桑尼亚都在寻找中国公司的替代品。”随着越来越多的撒哈拉以南国家效仿，“非中国”成为了土耳其公司的一个特色，而这是中国建筑商无法比拟的。■



A slow train from China

China's extraordinary export boom comes to an end

Covid-related supply bottlenecks meet slowing foreign demand

LAST MONTH a yellow-striped freight train rumbled into Budapest carrying solar-power equipment, air-conditioning kit and other bits and pieces. It had travelled for 16 days, all the way from Shandong, a province in eastern China. As part of China's Belt and Road Initiative, freight trains now serve more than 50 cities in Europe and Asia from Shandong. They are called "Qilu" trains, a nod to the ancient Qi and Lu kingdoms that flowered in that part of China in the Confucian era.

China's exports, whether by rail, road, sea or air, have made rapid progress in the past two years. They rose by almost 30% in dollar terms in 2021. Over 5,000 Qilu trains have left the station since 2018. But in April, China's export growth slowed to a desultory chug. In dollar terms, exports were only 3.9% higher than a year earlier.

Even that modest increase was something of a miracle. It came despite China's increasingly surreal battle against covid-19, which has locked down Shanghai, one of the country's biggest trade hubs, and imposed onerous restrictions on mobility elsewhere. According to Nomura, a bank, stringent limits remain in 41 cities, accounting for almost 30% of GDP. Towns have been so anxious to avoid outbreaks that officials have sealed lorry drivers into their cabs while they wait to pick up cargo at motorway checkpoints. These kinds of precautions have also gummed up international trade. In mid-April, 506 vessels were waiting outside Shanghai's port, according to Windward, a shipping-analytics firm, compared with 260 in February.

Optimists had hoped that China's export machine could weather occasional outbreaks of the Omicron variant. Workers, they pointed out, could isolate

themselves on the job, living where they work in a so-called “closed loop”. But no modern factory is entirely self-contained; every “closed” loop must remain open to its suppliers. And if any loop in the supply chain succumbs to the virus, it can disrupt production in all of them. Tesla’s car production in Shanghai has, for example, been hampered by a shortage of wiring harnesses from a virus-hit supplier, according to Reuters, a news agency.

To increase trade by any amount in these conditions is impressive. But the headline 3.9% expansion reported by China’s customs agency on May 9th was more nominal than real. More detailed statistics, published later in the month, are likely to show that the price of China’s exports rose by perhaps 8% or more in April, compared with a year earlier, according to UBS, a bank. If so, the volume of China’s exports must have shrunk last month.

These price increases have raised fears that a locked-down China will exacerbate inflation in its trading partners, particularly America. The alarm is often exaggerated. Goods made (in whole or in part) in China made up less than 2% of American personal consumer spending in 2017, according to economists at the Federal Reserve Bank of San Francisco. China’s covid-related bottlenecks could have larger ripple effects, say by allowing rival manufacturers to raise their prices. Most American inflation, however, is made in America.

Indeed, China’s exports may be more a victim of America’s woes than a cause of them. America’s slowdown is contributing to weaker demand for China’s goods on top of self-inflicted disruptions to their supply. Surveys of purchasing managers have revealed falling export orders every month so far this year. And China’s official statistics showed declining exports last month of the computers and household appliances that were in such high demand when the West too was locking itself down.

Not everything is slowing, however. China’s imports from Russia have

continued to grow since Vladimir Putin's invasion of Ukraine, as sanctions have hindered Russia's access to Western markets. The offerings included 50 carriage-loads of barley, carried to Shandong province on a Qilu train. ■



一列来自中国的慢车

中国非凡的出口热潮走到终点

疫情导致的供应瓶颈加上外国需求放缓

上个月，一辆车身绘有黄色条纹的货运列车轰隆隆驶入布达佩斯，车上载有太阳能发电设备、空调套件以及其他各式货物。这趟列车从中国东部的山东省一路驶来，跑了16天。作为中国“一带一路”倡议的一部分，从山东出发的货运专列如今已途经欧亚50多个城市。它们被称为“齐鲁号”班列，致敬儒家思想兴起时在山东崛起的齐国和鲁国。

过去两年里，无论是通过铁路、公路、海运还是空运，中国的出口都在高速增长。按美元计算，中国出口在2021年上升了近30%。自2018年以来，齐鲁号班列累计开行超过5000列。但在今年4月，中国的出口增长放缓，显出后继乏力的疲态。按美元计算，出口仅比去年同期增长3.9%。

能取得这一点增长也堪称奇迹。要知道此时中国正在实施越来越超现实的疫情防控措施，它最大的贸易枢纽城市之一上海陷入封城，其他地方也实施了限制人员流动的繁重举措。野村证券的数据显示，中国仍有41个城市在实施严格限制，它们占到全国GDP的近30%。乡镇为避免出现疫情紧张不已，甚至给在高速检查站等待取货的货车司机的驾驶室贴上封条。这类防范措施也妨碍了国际贸易。据航运分析公司Windward的数据，4月中旬，在上海港外等候装卸的货船有506艘，2月时只有260艘。

乐观人士曾寄望中国的出口能经受住奥密克戎疫情间或爆发的影响。他们指出，工人可以在工作场所生活，形成所谓的“闭环”来实现隔离。但没有哪家现代工厂是完全自给自足的，每个“闭环”都必须对其供应商保持开放。而只要供应链上任何一个环节被病毒攻破，整个链条的生产都会被扰乱。比如据路透社报道，由于供应商出现病例导致线束短缺，特斯拉在上海的工厂就陷入了停工。

在这种情况下出口还能有增长，无论多少都可堪赞叹。但中国海关总署5

月9日公布的这个3.9%的整体增幅是名义而非实际增幅。瑞银指出，本月早些时候公布的更详细的统计数据很可能会显示中国4月的出口价格同比上升了至少8%。如果是这样，那么中国上月的出口量一定是收缩的。

出口价格上涨引发了一些人担忧中国各地的封城会导致贸易伙伴的通胀加剧，特别是美国。这样的风险很多时候是被夸大了。旧金山联储的经济学家称，2017年，全部或部分在中国制造的商品在美国个人消费支出中占比不到2%。中国因疫情造成的供应瓶颈可能造成更大的涟漪效应，例如使得竞争对手制造商得以借机提价。但是，美国的通胀大部分是美国自己制造的。

事实上，中国出口更可能是美国经济困境的受害者，而非加害者。在中国自己扰乱商品供应的同时，美国经济放缓也在导致对中国商品的需求减弱。对采购经理的调查显示，今年迄今每个月的出口订单都在减少。而中国官方统计显示，计算机和家电出口在上月出现下降，这些商品在此前西方国家封城期间需求极高。

但是并非一切都在放缓。普京入侵乌克兰后，制裁措施阻碍俄罗斯进入西方市场，中国持续扩大从俄罗斯的进口。其中包括50车大麦，由齐鲁号班列运往山东省。■



Killer apps, saving lives

Apps interpreting data from wearable devices are helping people to live better

But too many of the apps are poorly designed

IT IS A TRENDLINE that gives you pause: a spike nearing the top of the blue band that marks your normal blood-sugar range, followed by a sharp dip. The culprit is obvious: the sourdough toast for breakfast half an hour before. A generous piece of banana bread the following morning leaves a completely different trace. The blood-sugar line runs nicely unperturbed right down the middle of the normal zone all the way through to lunchtime.

These are the sort of revelations that a continuous glucose monitor, a coin-sized device attached to the skin, beams to your smartphone's screen. The device lasts for two weeks and has a tiny needle that gets just under the skin. Every few minutes it measures the concentration of sugar in the fluid between the cells there—a good proxy for what is going on in the bloodstream.

Almost as soon as the first such continuous glucose monitors started replacing finger-prick blood tests for diabetics in 2014, they began to show up on the arms of non-diabetic geeks in Silicon Valley. They were looking for ways to “hack” their metabolism into delivering, for instance, more energy or brain clarity. Their ad-hoc experiments were soon replicated by formal researchers doing broader studies of metabolism. Those, in turn, have led to the possibility of personalised nutrition.

Such metabolic studies have changed the scientific thinking on what a healthy diet looks like. It has turned out that many seemingly healthy people often have large post-meal spikes in blood sugar, which have been linked to the development of pre-diabetes. Without any intervention pre-

diabetes turns into diabetes in 37-70% of cases within four years. The sugar dips that often follow the spikes were recently found to be problematic, too, because they make people feel hungry. People who are “big dippers” consume about 300 more calories a day than those who are not.

In 2015 researchers in Israel showed that an AI-based algorithm they had developed could predict someone’s blood-sugar reaction to various foods. The algorithm’s inputs included blood tests, sleep, exercise, height and weight, which all affect daily metabolic variations. They also included the composition of the gut microbiome, the trillions of bacteria residing in the gut whose collective job is to process what we eat. Microbiome analysis is done by shotgun genomic sequencing of everything found in a stool sample.

In the past five years startups in America, Europe and Asia have launched AI-based personalised-nutrition apps that build on these discoveries. One of them, Zoe, sends customers a set of specially formulated muffins. By knowing exactly what is in the food being eaten, and measuring the changes in blood sugar and fat that come about in response, the company can create a predictive model of its customers’ metabolism. Its algorithm then whips up a bespoke catalogue of foods and meals, with predicted blood-sugar reactions to each. Tushar Vashisht, co-founder of HealthifyMe, an Indian startup that provides digital coaching for weight loss, says the trove of data from customers who can afford various connected devices and blood tests as inputs for their bespoke plans is useful far beyond those customers. It can help to build apps for people who do not have such devices, which would rely on AI-derived proxies of weight, blood sugar and so on.

For such systems to keep metabolisms in balance, they have to be adhered to. Knowing what is happening inside your body is no help if you do nothing to change the pattern of behaviour involved. Just being told that it

is in your interests is not, typically, enough. So apps sold as ways of achieving health gains on the basis of measurements made by wearables typically incorporate a variety of behavioural nudges to keep the user focused.

The AI innovation in such personalised diets makes them easier to maintain in the long term because it gives people options on how to make the foods that the algorithm says are particularly bad for them a little less bad. The algorithms may suggest small tweaks, such as sprinkling some nuts on that ice cream or going for a long walk after eating it. January AI, another personalised-nutrition startup, says it has derived the nutrition contents of 16m grocery-store items, recipes and menus of local restaurants, which makes it easier for users to plan and track meals.

It is still early days, but results reported by users of such precision-nutrition programmes look encouraging. Users say they are losing weight, have higher energy levels and are sleeping better. Some diabetic users no longer need medication. Studies of several apps are under way to confirm and quantify these benefits.

However, thoughtful suggestions that make compliance easier are the exception. As too often with the design of new tech products, behavioural science is an afterthought. When she began researching her book, Natasha Schüll, the cultural anthropologist from NYU, found trying to decode the logic behind many health-tech products very frustrating. Then she realised that there was no logic. It was “a pinch or two of positive psychology thrown in with the infrastructure of a punitive Skinner box, thrown in with some other notion of the brain” ending up as “a hotch-potch of ad-hoc things that was not that studied or scientific”. The typical design strategy, she concluded, “was just throwing things at the wall”.

This may be why many of the apps fail to establish themselves in people’s

lives (see chart). There are more than 400,000 health and wellness apps on the Apple and Google app stores with 250 new ones added daily. Appetite for them is healthy, with around 5m app downloads per day. But 95% of those downloads will be deleted within 24 hours.

The problem is that people do not just need a product that is well designed. They need a product that is well designed for them, says Liz Ashall-Payne from Orcha, a British organisation that evaluates the quality of health apps for clients like the National Health Service. As she points out, buying a pair of trousers online is made easy by filters for size, colour and style, but no such system exists on the app stores. A teenager seeking help for anxiety will need a different type of app to his grandparent wanting the same thing.

| *A lot of dead wood*

Orcha has rated 7,000 health apps on three criteria: privacy, user experience and evidence that they work. Only about a quarter of them meet its quality threshold on all three. Mental-health apps are particularly weak. But quality is improving, says Ms Ashall-Payne. She attributes that to the guidelines for health apps that were set recently by British health authorities, which gave developers clarity on what “good” looks like. As the market matures the bad products will die out, “but it’s going to take time”.

Making people stick to healthy behaviours is probably the biggest challenge in public health. That makes innovations which boost compliance particularly exciting. Technology developed by Sweetch, an Israeli startup, is making the advice dispensed by health apps more practical and personalised. Sweetch’s AI-based algorithm is a hybrid of a personal secretary and a motivational coach. It keeps track of whatever it is the user must do, such as walking a certain number of steps or checking their weight weekly, and finds the best time to suggest they do it.

The vigilant bot may spot, for example, that you have a 20-minute gap

between meetings and suggest you pop out for a walk to the coffee shop a few blocks away to do your steps. It changes your activity goals up and down depending on how you are doing, to prevent you from becoming demotivated and ditching the whole thing. The prompts are available in 33 different tones of voice: combinations of words that can be friendly, begging, commanding and so on. Yoni Nevo, Sweetch's chief executive, says that the algorithm evaluates about 700m possible combinations of things to say to an individual on any given day. It takes about four to five weeks for the algorithm to learn what makes you tick by trying different combinations of all these things.

Device manufacturers, for their part, are starting to realise that when it comes to giving people health data, less is sometimes more. Many people are happier when they are simply told whether things are fine or not, rather than being flooded with all sorts of data to make sense of before breakfast. Some smart scales now just buzz approvingly when you step on them to confirm that your weight and body-fat composition are in your target range, rather than giving you the metrics. Wearables like the Oura ring are now able to tell you not just what your heart rate, sleep or temperature trends are, but also what that means—and what changes might improve things. And when the data show that things have gone off kilter, novel digital treatments may come to the rescue. ■



挽救生命的杀手应用

解释可穿戴设备数据的应用帮助人们改善生活

但太多应用设计不佳【专题《量化的我》系列之一】

这是一条让你警觉的趋势线：它上冲到了显示你正常血糖范围的蓝色区域的顶部附近，然后急剧跌落。罪魁祸首显而易见：半小时前的早餐吃下的酸种吐司面包。第二天早上，一大块香蕉面包留下了截然不同的轨迹。血糖曲线平稳穿过蓝色区域的中部，直至午餐时分都波澜不惊。

这些曲线是一台持续监测血糖仪向你的智能手机屏幕发送的启示。这种硬币大小的设备附着在你的皮肤上，可以使用两周，带有一根能稍稍刺入皮下的微针。每隔几分钟，它会测量这个部位的细胞间组织液中葡萄糖的浓度——这个指标能很好地反映血液中的情况。

第一批这样的连续监测血糖仪于2014年开始取代糖尿病患者的手指采血检测。几乎与此同时，它们开始出现在并没有患糖尿病的硅谷极客们的手臂上。这些人要想办法“侵入”自己的新陈代谢以提升自己的精力或是让大脑更清楚。他们临时开展的实验很快被从事更广泛新陈代谢研究的正式研究团队复制。这继而又带来了个性化营养的可能性。

这类代谢研究改变了科学有关健康饮食的看法。人们发现，许多看似健康的人在用餐后往往血糖水平大幅升高，而这已被发现与糖尿病前期的发展相关。如果不做任何干预，糖尿病前期有37%到70%会在四年内发展为糖尿病。近期研究发现，常在峰值后出现的血糖骤降也是个隐患，因为它令人感到饥饿。那些“坐过山车”的人相比其他人每天要多摄入约300卡路里热量。

2015年，以色列的研究人员展示了他们开发的一种基于人工智能（AI）的算法，可以预测一个人对各种食物的血糖反应。该算法的输入包括验血结果、睡眠、锻炼、身高和体重，这些都会影响每日的代谢变化。它还包括肠道微生物组的构成，这个微生物组指的是寄居在肠道中的数以万亿计的

细菌，它们的集体工作是处理我们吃下的东西。微生物组分析是通过对在粪便样本中发现的所有物质做鸟枪法基因组测序来完成的。

过去五年里，美国、欧洲和亚洲的创业公司在这类新发现的基础上，推出了基于AI的个性化营养应用。其中一家公司Zoe向客户派送了一组特殊配方的松饼。通过准确了解摄入食物的成分，并测量随之而来的血糖和脂肪变化，该公司创建了一个预测其客户新陈代谢的模型。然后，其算法会生成一个定制化的食物和餐品目录，逐个列出它们的预期血糖反应。用数字手段指导减肥的印度创业公司HealthifyMe的联合创始人图沙尔·瓦谢希特（Tushar Vashisht）表示，有财力为定制减肥计划购入各种联网设备和做各种血液检测的客户带来了大量个人数据，其用处远远超出了客户本身。这些数据有助于为没有这类设备的人构建应用，依赖一些由AI推导出的指标来替代体重和血糖。

若你要用这类系统来维持代谢平衡，你必须得坚持遵守系统的要求。单单了解体内正在发生什么是没有用的，如果你完全不改变相关行为模式的话。仅仅和你说这是为了你好往往也是不够的。因此，基于可穿戴设备的测量结果来改善健康的应用通常也内置了各种行为助推器，让用户能够保持专注。

这类个性化饮食中的AI创新使得人们更容易长久坚持下去，因为它给用户提供了一些选项，把那些算法认为尤其不利于健康的食物变得稍稍不那么糟糕一些。算法可能会建议你做小小的调整，比如在冰淇淋上撒一些坚果，或者在吃完冰淇淋后散个步。另一家个性化营养创业公司January AI表示，它已经推导出了1600万种食品杂货店商品、食谱和本地餐馆菜单的营养构成，便于用户规划和追踪自己的膳食。

精准营养仍处于早期阶段，但此类方案的用户自报的结果令人鼓舞。用户说他们体重减了，更有活力了，睡得更好了。一些糖尿病患者不再需要用药。人们正在对一些应用开展研究来证实和量化这些好处。

但是，说到能提高依从性的深思熟虑的建议，就没那么乐观了。新款科技

产品的设计中往往会出现这种情况：行为科学是最后才想到的东西。当纽约大学的文化人类学家娜塔莎·许尔（Natasha Schüll）开始为自己的书做调研时，她发现要解读许多健康科技产品背后的逻辑是件非常令人泄气的事。然后她意识到，并没有什么逻辑。那是“在惩罚性的斯金纳盒子的基础构架中加入一两条积极心理学，再加一些关于大脑的概念”，最终成为“没有经过多少研究或有多少科学依据的临时拼凑的大杂烩”。典型的设计策略，她总结道，“不过就是啥都试试，碰碰运气”。

这可能就是为什么许多应用自身没能在人们的生活中站稳脚跟的原因（见图表）。苹果和谷歌的应用商店中有超过40万款健保应用，每天新增250款。对它们的需求也很可观：每天约有500万次下载应用。但是，其中95%的下载会在24小时内被删除。

这里的问题在于人们不仅仅需要一款精心设计的产品。他们需要一款“为他们”精心设计的产品，英国组织Orcha的利兹·阿歇尔-佩恩（Liz Ashall-Payne）说。Orcha为英国国民医疗服务体系（NHS）等客户评估健康类应用的质量。正如她所说，在网上买一条裤子很容易，因为可以按照尺寸、颜色和款式筛选；但应用商店中不存在这样的筛选系统。一个想为焦虑问题寻求帮助的青少年所需要的应用，和他同样想要缓解焦虑的祖父母所需的是不一样的。

| 大批淘汰

Orcha根据三项标准给7000个健康应用评级：隐私、用户体验，以及有效性证明。其中只有约四分之一在所有三个方面都达到了它设立的质量门槛。心理健康应用尤其不怎么样。但阿歇尔-佩恩说质量正在提高。她将这归功于英国政府卫生部门近期制定的健康应用指南，让开发人员清楚地了解到“好”的应用是什么样的。随着这个市场走向成熟，劣质产品会被淘汰，“但这需要时间”。

让人们坚持健康的行为方式可能是公共卫生领域面临的最大挑战。这就使得能够提高依从性的创新特别令人兴奋。以色列创业公司Sweetch开发的技术正在把健康应用给出的建议变得更实用也更个性化。Sweetch基于AI

的算法是私人秘书和激励型教练的混合体。它跟踪用户必须做到的所有事，比如走一定的步数或每周称重，并找到最合适的时候来敦促他们这样做。

例如，警觉的机器人可能会发现你在会议之间有20分钟的空档，于是建议你出去散个步，走到几个街区外的咖啡店，这样就完成了一些步数。它会根据你当前的进展对目标做增减调整，以防你心灰意冷整个放弃。它以不同词汇组合而成的提示有33种不同的语气：可以是友好的、恳求的、命令的，等等。Sweetch的首席执行官约尼·内沃（Yoni Nevo）表示，算法评估了大约七亿种可在一天里对一个人说的内容组合。算法需要大约四五周时间尝试所有这些内容的不同组合来得出什么对你有效。

就设备制造商而言，他们开始意识到，在为人们提供健康数据时，有时少即是多。许多人宁愿被简单告知是不是一切安好，而不是在早餐前琢磨一大堆数据是什么意思。现在，一些智能体重秤只会在你踩上去时发出“赞许”的声响，向你确认体重和体脂率在目标范围内，而不再给你看数字。像Oura戒指这样的可穿戴设备现在不仅可以告诉你心率、睡眠或体温走势，还可以告诉你这意味着什么——以及做些什么改变可能会改善情况。而当数据显示事态开始偏离正轨时，新的数字疗法可能会前来救驾。■



The pulse of the people

Data from wearable devices are changing disease surveillance and medical research

This is giving new insights into the health of millions of people

AS SOON AS the covid-19 pandemic began, several research institutes around the world set up studies asking people to share data from their wearable fitness trackers. On most devices, signing up involved just a few clicks, and people did so enthusiastically. The biggest study, the Corona Data Donation project set up by the Robert Koch Institute in Germany, enrolled more than 500,000 people. Over 30,000 signed up for DETECT, a study by the Scripps Research Institute in California.

When it comes to disease surveillance, the most useful biomarker is fever, a direct sign of infection. But most wearables do not measure temperature, because accurate readings are hard to do. So a proxy had to be created using the standard things they do measure, such as heart rate, sleep and activity level. Resting heart rate, measured when people are sitting still, varies a lot from person to person—anything between 50 and 100 beats per minute counts as normal—but each person's rate is generally stable. When the body fights an infection, however, the rate goes up, often dramatically. With covid-19, data from wearable devices showed that this uptick happened four days before people felt any symptoms. By one estimate 63% of covid cases could be detected from changes in resting heart rate before the onset of symptoms.

Before covid came along, a team from Scripps led by Jennifer Radin had shown that, in America, weekly changes in the proportion of people with abnormal results in heart rate, sleep and activity—all measured from wearables—align neatly with the prevalence of flu-like symptoms as measured by established surveillance systems. These track flu outbreaks by

canvassing doctors' offices to find out if more people with such symptoms are starting to show up. Because people usually seek care 3-8 days after symptoms appear, by the time these data are collated, an epidemic is usually at a different stage, possibly requiring different public-health measures. More timely insights are sorely needed.

That said, data from wearables have quirks of their own. One day the Koch Institute team saw a sudden peak in the measurement derived from step count and heart rate they were developing as a proxy for fever. It turned out that Apple had changed the algorithm that calculates resting heart rate on its devices. Such software updates have been a headache for the team because their data come from about a dozen different devices. They also have to sort out various gaps. Apple Watches are usually charged at night, which means that they give no sleep data. Once through its teething problems, though, the project proved a success. "It is not 100% accurate but it does a pretty good job," says Dirk Brockmann, who leads the team.

Other research teams have taken a different approach to population-based surveillance with wearable devices. They have developed algorithms that examine deviations in each individual's metrics, based on whatever data their particular device collects. They establish the person's baseline levels of various biomarkers and then look for changes that suggest he may be experiencing some sort of anomaly in physiology. When lots of such changes occur all of a sudden, different as they may be from person to person, it is reasonable to suspect that lots of people are falling ill, and probably from the same thing.

One thing researchers now need to work out is whether the disease-surveillance algorithms based on wearable devices might systematically miss what is happening with some types of people, says Leo Wolansky from the Rockefeller Foundation's Pandemic Prevention Institute. For example, algorithms might unwittingly be optimised for spotting outbreaks in

wealthy areas where people are more likely to have been using high-end wearables for longer. In poorer areas, where people may have different underlying health conditions (which often affect digital-biomarker measurements), the algorithm for wearables might be a lot more likely to miss an outbreak. “As they often say in this field, ‘Garbage in, garbage out’, and we still have to better understand whether the data we’ve captured has some garbage in it,” says Mr Wolansky.

Medical scans that look for a particular problem routinely turn up other things, known as incidental findings. Something similar has occurred with the mass scan of human bodies that has taken place thanks to all these data from wearables. The German team found that resting heart rate was higher in areas that had been in East Germany than those in former West Germany. “We still don’t know why this is,” says Mr Brockmann. “Is it because women work more in East Germany? Or is it because people eat differently?”

Another mysterious finding is that Germans in all parts of the country are sleeping less in 2022 than in 2020 and the resting heart rate of the nation has gone up. One guess is that this may have to do with the extra weight that people put on during lockdowns, but nobody really knows for sure. The data from wearables has been “a question generator”, says Mr Brockmann, raising queries about health that would not have been asked otherwise.

The ability to examine lots of human bodies as they go about their daily lives is also changing how clinical studies of new drugs are done. According to IQVIA, a research firm, 10% of late-stage clinical trials in 2020 used connected devices to monitor people, up from 3% in 2016. A catalogue by the Digital Medicine Society, an American organisation, lists more than 300 examples of digital biomarkers that are used in trials.

Activity measures, such as step count, for example, are a formal outcome in

drug trials for asthma, arthritis, heart failure, Parkinson's disease and cystic fibrosis. Measuring how much a person walks can provide a more objective, or at least complementary, picture of a drug's effect on pain or mood than the standard practice of asking people to give a rating on a scale.

Most important, devices that unobtrusively monitor patients as they go about their lives have allowed medical researchers to see, for the first time, how patients experience a given disease and treatment in their natural habitat. Nobody sleeps well in a pharmaceutical company's sleep lab. The most widely used test of cardiovascular and physical fitness is the "six-minute-walk test", which is the distance that someone can walk in the span of six minutes. It involves a patient pacing up and down a hospital corridor while a nurse with a clipboard records the result.

This has been simplified by fitness trackers, some of which have added the six-minute test to their repertoire of movement metrics. An Apple Watch, for example, makes its estimates using multiple metrics from its sensors that are passively observed over long periods of a user's normal behaviour (rather than a single six-minute walk). Validation studies in people over 65 show that this algorithmic estimate is highly accurate.

The inclusion in drug trials of measures that reflect patients' quality of life might help people choose treatments that best suit their priorities. At the moment, new cancer drugs are considered a success even if they prolong patients' lives by just a few months. Many cancer patients, however, care much more about what they can do in the months that they survive the disease than about stretching their lives a little longer.

They would choose a treatment that might promise fewer extra days but a greater chance that they would be able to do what matters to them, such as being able to lift up their grandchildren. Pharmaceutical companies are starting to include such metrics among the goalposts they set for new

drugs.

Wearable sensors have also opened clinical trials to patients who would otherwise be excluded from them, says Andy Coravos from HumanFirst, an organisation which helps drug companies deploy connected devices for monitoring trial participants at home. She raises the example of Duchenne muscular dystrophy, a muscle-wasting disease. The typical primary outcomes for medicines developed for the disease are a six-minute-walk test and a four-stair climb test. But 60% of sufferers are in wheelchairs, which means that they cannot participate. So it is unclear what the treatments can do for them. An armband tracking upper-body motion makes it possible to include them in trials.

Academic studies of non-drug interventions, such as behavioural nudges to increase physical activity, are also using more data from fitness trackers rather than asking participants to keep a diary or fill in a questionnaire. One analysis of clinical trials registered in America found that the number using connected devices grew from 88 in 2007 to more than 1,100 in 2017. The majority of those trials have not been by pharmaceutical companies, but by research organisations such as the group led by Euan Ashley at Stanford University which focuses on precision medicine.

Dr Ashley's group was among the first to run, in 2019, a fully digital trial in which participants never met a researcher face-to-face. Not long ago, he says, recruiting trial participants involved putting up posters with tear-off bits of paper listing a number for them to call. They would then need to go to the hospital and sit down with a nurse to go over 17 pages of consent forms to sign up. "If you could get 200 people in a few months, you'd be pretty happy," he says.

Now, people can download the app for a study and sign up while waiting in line for their coffee. The first time Dr Ashley's team used this method for a

study on physical activity 40,000 people enrolled in just two weeks and results were ready in a matter of months. That was not an unalloyed benefit. Though the study was very easy to join, it was also very easy to leave and about 80% of participants had dropped out before the end, which was just two weeks in. Even so, the final group was about ten times the usual size for this line of research.

| *The quantified life*

This report has argued that wearable health and fitness trackers can change the way people try to stay healthy and alleviate illness, the way their doctors care for them, and the way population-level health interventions are deployed. The digital health care that wearables enable could make treatment more efficient, personalised and effective. In America digital therapies are used by lots of people who might otherwise not receive care at all. Mental-health care from an AI-therapist may not always be as good as from a human being. But it can be accessed a lot more easily by people who cannot afford the payment or time off to see a doctor, or where there is a shortage of mental-health specialists.

Automated, round-the-clock monitoring of patients with chronic conditions (the biggest users of health care) can greatly improve their treatment and outcomes. Done right, it can also help doctors treat more of them without being overstretched. This model of care can make a big difference in poor countries, where there are not enough specialists.

About a third of deaths globally are from cardiovascular disease and more than three-quarters of those deaths are in low- and middle-income countries. It may seem hard to imagine that wearable devices with heart-monitoring functions will become widespread in developing countries like India. But look at smartphones. In 2021, 54% of Indians already owned one. Deloitte, a consulting firm, reckons that by 2026, the country will have 1bn smartphone users, and will be the world's second-biggest manufacturer of

the devices. Many African countries have skipped developing a personal-banking sector by establishing mobile-phone payment systems that are now used for almost everything.

But even in a developed country like America, a digital divide exists whereby many people cannot afford internet access or lack the digital literacy needed to make use of new health technology. The new sensors and wearables technology are all very exciting, says Yuri Maricich of Pear Therapeutics, but “how can we reduce that to something that [works for] a single mom in the state of Kentucky who is in a very difficult life situation, or a trucker who is always on the road and trying to make ends meet?”

This sort of question is, all too often, an afterthought when new consumer technologies are being developed. To ignore it with digital-health products would be squandering a big opportunity to improve health care for all. ■



人民的脉搏

来自可穿戴设备的数据正在改变疾病监测和医学研究

这为千百万人的健康提供了新的见解【专题《量化的我》系列之二】

新冠疫情伊始，世界各地的几家研究机构就开展了研究，请人们分享来自可穿戴健身追踪器的数据。在大多数设备上，只需点击几下就可参与了，人们的响应非常积极。最大的一项研究是德国罗伯特科赫研究所（Robert Koch Institute）设立的新冠数据捐赠项目，招募了超过50万人。三万余人报名参加了加州斯克里普斯研究所（Scripps Research Institute）的DETECT项目。

在疾病监测方面，最有用的生物标志物是发烧，这是感染的直接迹象。但大多数可穿戴设备不测量体温，因为很难做到读数准确。因此，必须使用它们测量的标准项目作为指标，例如心率、睡眠和活动水平。当人们静坐不动时测量的静息心率因人而异——每分钟跳动50到100次都算正常——但每个人的静息心率通常是稳定的。然而，当身体对抗感染时，静息心率通常会急剧上升。在新冠肺炎感染中，来自可穿戴设备的数据显示，在人们感到任何症状的四天前就会发生静息心率上升。据估计，在出现症状前，63%的新冠病例可以从静息心率的变化中检测出来。

在新冠疫情之前，由珍妮弗·雷丁（Jennifer Radin）领导的斯克里普斯团队已经证明，在美国，心率、睡眠和活动异常的人群比例的每周变化——所有这些数据都来自可穿戴设备——与已建立的监测体系测量的类流感症状的流行情况吻合得很好。这些体系追踪流感爆发的方法是对医生办公室进行调查，以了解是否有更多有此类症状的人开始出现。由于人们通常在出现症状的3到8天后就医，因此在收集到这些数据时，流行病通常已处于另一个阶段，可能需要采取不同的公共卫生措施。对更及时的观测方法的需求迫在眉睫。

话虽如此，来自可穿戴设备的数据有其自身的怪异之处。有一天，科赫研究所的团队看到根据步数和心率推导出的一个测量值出现了突发的峰值，

这个指标是用来衡量发烧的。最后发现，这是因为苹果改变了计算其设备上静息心率的算法。这样的软件更新一直让团队头疼，因为数据来自十几种不同的设备。他们还必须考虑到各种空白。Apple Watch通常在晚上充电，这意味着它们不会提供睡眠数据。不过，解决了初期的问题后，项目成功了。“它不是100%准确，但还是相当不错的。”领导团队的德克·布洛克曼（Dirk Brockmann）说。

其他研究团队采用了不同的方法来处理可穿戴设备对人群的监控。他们开发了算法，根据其特定设备收集的数据来检查每个人的指标偏差。他们为个体建立各种生物标志物的基线水平，然后寻找能够体现他可能正在经历某种生理异常的变化。当很多这样的变化突然发生时，尽管变化本身可能因人而异，但有理由怀疑很多人生病了，而且很可能是因为同一件事。

洛克菲勒基金会疫情预防研究所的雷奥·沃兰斯基（Leo Wolansky）说，研究人员现在需要弄清楚的一件事是，基于可穿戴设备的疾病监测算法是否会系统性地忽略某些类型的人群正在发生的事情。例如，算法可能会在不知不自觉中进行优化以发现富裕地区的疫情，那里的人们更有可能长时间使用高端可穿戴设备。在较贫困的地区，人们可能有不同的潜在健康问题（这通常会影晌数字生物标志物的测量），导致可穿戴设备的算法更有可能错过爆发。“正如他们在这个领域经常说的那样，‘垃圾进，垃圾出’，我们仍然需要更好地了解我们捕获的数据是否包含一些垃圾。”沃兰斯基说。

寻找特定问题的医学扫描经常会发现些别的东西，称为偶然发现。因为有了来自可穿戴设备的大量数据而成为可能的人体大规模扫描也发生了类似的事情。德国团队发现，东德地区的静息心率高于前西德地区。“我们仍然不知道这是为什么，”布洛克曼说，“是因为东德的女性工作更多吗？还是因为人们的饮食方式不同？”

另一个神秘的发现是，德国各地的人在2022年的睡眠时间都比2020年少，而全国的静息心率都在上升。一种猜测是，这可能与人们在封锁期间增长的体重有关，但没有人有确切答案。布洛克曼说，来自可穿戴设备的数据

一直是个“问题生成器”，提出了原本不会被提出的健康问题。

在日常生活中检查大量人体的能力也正在改变新药临床研究的方式。根据研究公司艾昆纬（IQVIA）的数据，2020年有10%的后期临床试验使用了联网设备来监测人员，高于2016年的3%。美国组织数字医学协会（Digital Medicine Society）的目录列出了300多个数字生物标志物用于试验的例子。

例如，活动测量指标（例如步数）是哮喘、关节炎、心力衰竭、帕金森病和囊性纤维化药物试验的一项正式结果。要衡量药物对疼痛或情绪的影响，与要求人们在量表上打分的标准做法相比，测量一个人的行走量可以提供更客观的（或至少是补充性的）参考。

最重要的是，有了在患者生活过程中不张扬地开展监测的设备，医学研究人员第一次看到了患者在其自然生活环境下中对特定疾病和治疗的体验。在制药公司的睡眠实验室里，没有人睡得很好。最广泛使用的心血管和身体健康测试是“六分钟步行测试”，即一个人在六分钟内可以步行的距离。它要让患者在医院走廊上来回踱步，而护士则拿着笔记本记录结果。

健身追踪器把它简化了，其中一些已经将六分钟测试添加到运动指标库中。例如，Apple Watch使用来自其传感器的多个指标进行估计，这些指标是在用户长时间的日常行为（而不是单次步行六分钟）中被动采集的。对65岁以上人群的验证研究表明，这种算法的估计非常准确。

在药物试验中纳入反映患者生活质量的测试，可能有助于人们选择最适合自己优先事项的治疗方法。目前，哪怕只能将患者的生命延长几个月，新的抗癌药物就算是成功的。然而，许多癌症患者更关心他们在带病生存的几个月内能做些什么，而不只是把生命延长一点点。

他们会选择的治疗方法可能会承诺更少的生存天数，但更可能让他们能做对他们来说重要的事情，比如能够抱起孙辈。制药公司开始将这些指标纳入为新药设定的目标中。

HumanFirst的安迪·科拉沃斯（Andy Coravos）说，可穿戴传感器还可以把那些原本会被排除在外的患者纳入临床试验，该组织帮助制药公司部署联网设备，以在家中监测试验参与者。她举了杜氏肌营养不良症的例子，这是一种肌肉萎缩症。针对该疾病开发的药物的典型主要结果是六分钟步行测试和四段楼梯攀登测试。但60%的患者坐在轮椅上，这意味着他们无法参与试验。因此，这些治疗可以为他们做什么尚不清楚。一个跟踪上身运动的臂带可以将他们纳入试验。

对于非药物干预（例如增加运动的行为助推器）的学术研究也在使用更多来自健身追踪器的数据，而不是要求参与者记日记或填写问卷。一项对在美国注册的临床试验的分析发现，使用联网设备的试验数量从2007年的88个增加到2017年的1100多个。这些试验大多数都不是制药公司做的，而是由研究机构进行，例如由尤安·阿希礼（Euan Ashley）领导的专注于精准医学的斯坦福大学团队。

阿希礼博士的团队在2019年率先开展了一项完全数字化的试验，参与者从未与研究人員面对面交流。他说，不久前，招募试验参与者需要张贴带有可撕下纸条的海报，纸条上列出了可以拨打的电话号码。然后，参与者需要去医院，和护士一同坐下来查看17页的同意书才能加入。“能在几个月内招到200人那就相当满意了。”他说。

现在，人们可以下载用于研究的手机应用，并在排队等咖啡时注册。阿希礼的团队首次使用这种方法进行一项关于运动的研究时，短短两周内就有四万人参与，几个月内就得出了结果。这件事并不是有百利而无一弊。虽然加入研究很容易，但退出也很容易，大约80%的参与者在监测结束前，也就是区区两周内退出了。即便如此，最后入组的人数大约是这一研究方向常见规模的十倍。

| 量化的人生

本报告认为，可穿戴健康和健身追踪器可以改变人们试图保持健康和减轻疾病的方式、医生提供护理的方式，以及部署人群级健康干预措施的方式。可穿戴设备实现的数字医疗保健可以使治疗更加迅捷、个性化和有

效。在美国，数字疗法触及了许许多多原本可能根本得不到护理的人群。来自人工智能治疗师的心理健康护理可能并不总是像人类提供的那样好。但是，对于那些没钱看病或怕影响收入不敢请假的人，或是在心理健康专家短缺时，获得这种服务要容易得多。

对慢性病患者（医疗保健的最大用户群体）进行自动、全天候的监测可以大大改善治疗和结果。做得好的话，它还可以帮助医生治疗更多的病人，而不会超负荷工作。这种医疗模式可以在没有足够多的专家的贫困国家产生重大影响。

全球约三分之一的死亡由心血管疾病导致，这其中有超过四分之三的死亡发生在低收入和中等收入国家。似乎很难想象具有心脏监测功能的可穿戴设备会在印度等发展中国家普及。但是看看智能手机。到2021年，54%的印度人已经拥有它了。咨询公司德勤估计，到2026年，印度将有10亿智能手机用户，并将成为全球第二大智能手机生产国。许多非洲国家通过建立现在几乎处处通用的手机支付系统，跳过了发展个人银行部门的阶段。

但即使在美国这样的发达国家也存在数字鸿沟。许多人负担不起互联网接入费用，或缺乏利用新的健康技术所需的数字素养。Pear Therapeutics公司的尤里·马里西奇（Yuri Maricich）说，新的传感器和可穿戴设备技术确实非常令人兴奋，但“我们如何才能将它简化，让肯塔基州生活非常困难的单身母亲，或者总是在路上并试图维持生计的卡车司机（也能用上它）？”

在开发新的消费技术时，这类问题往往是事后才想到的。在普及数字健康产品时忽视它，将浪费一个改善全民医疗保健的大好机会。■



Medicine

Wearable technology promises to revolutionise health care

Do not let bureaucracy delay matters

IT IS A stealthy killer. When the heart's chambers beat out of sync, blood pools and clots may form. Atrial fibrillation causes a quarter of more than 100,000 strokes in Britain each year. Most of those would never happen if the heart arrhythmia were treated, but first it has to be found. Tests are costly and inaccurate, but Apple Watches, and soon Fitbits, can detect it, are far cheaper and can save those whose lives are in danger.

This is just one example of the revolution about to transform medicine. Smartwatches and -rings, fitness trackers and a rapidly growing array of electronically enhanced straps, patches and other “wearables” can record over 7,500 physiological and behavioural variables. Some of them are more useful than others, obviously, but, as our Technology Quarterly in this issue explains, machine learning can filter a torrent of data to reveal a continuous, quantified picture of you and your health.

These are early days for the quantified self, and for investors in digital health it is still a wild ride. Witness the recent collapse in the share price of Teladoc, which provides online consultations, a worrying sign for other would-be disrupters. But for patients the innovation in wearable devices has just begun. Individual firms may come and go, but wearables and artificial intelligence look set to reshape health care in three big ways: early diagnosis, personalised treatment and the management of chronic disease. Each promises to lower costs and save lives.

Start with early diagnosis. Wearables can detect subtle changes that otherwise go unnoticed, leading to less severe disease and cheaper treatment. Sensors will reveal if an older person's balance is starting to

weaken. People's gait and arm-swing change in early-stage Parkinson's. Strength exercise can help prevent falls and broken limbs. Psychiatric diagnosis may be enhanced by tracking patterns of smartphone use—without monitoring what people see or type. A smart ring can help a woman conceive, by predicting her menstrual cycle. It can also detect pregnancy less than a week after conception (many women continue to drink or smoke for weeks before they realise they are pregnant).

Then there is the promise of seeing people as individuals, not clones of the theoretical, average human. Most drugs work in just 30-50% of patients. In one person, regularly eating bananas moderates blood sugar; in another, it raises blood sugar to levels that, over time, can cause harm. Algorithms can turn reams of data from wearables into bespoke prescriptions and diets for losing weight, controlling diabetes and so on. These regimes are more effective, less limiting and hence easier to follow than the one-size-fits-all kind. When doctors can see into a patient's body in real time all the time, they can provide better care. In a German trial this sort of monitoring of heart-failure patients reduced mortality and the days spent in hospital by a third.

And wearables can transform chronic diseases, such as diabetes. Some 80% of disease can be prevented by changes in how people lead their lives. Apps use small devices and clever tactics of the sort employed by a personal trainer or a shrewd spouse to get people to move more, eat better and sleep more soundly. Inducing even small increases in exercise is good: adding 1,000 steps (0.7km) a day reduces mortality by 6-36% depending on how sedentary you are. Continuous monitoring also shifts the balance of care from what doctors can do in the brief occasional office consultation to what patients can do for themselves day in, day out. America spends \$10,000-20,000 a year per patient with diabetes and about \$280bn a year nationally, half the entire public-school budget. A diabetes-control app has been shown to reduce the cost per patient by \$1,400-5,000.

The scale of all these benefits promises to be vast. Just how vast will become clearer as wearables create data, leading to innovation. The reason for optimism is that the technology is ripe. Some 200 million devices were sold in 2020 and twice as many are expected to sell in 2026. One in four Americans has a wearable device. Smartphones serve as a platform for innovators. Within a year or two the device on your wrist may be measuring non-invasively your blood sugar, alcohol and hydration, as well as various markers of inflammation, kidney and liver function—all of which currently require blood to be drawn. As wearables acquire more features, users are less likely to lose interest in them and shove them into the back of a drawer.

As with any technology, wearables bring worries. Health data are valuable; they could be abused by device-makers, insurers or governments interested in social control. The technology may not reach the poor and those who lead chaotic lives—the people who need it most. But the greatest worry is that the bureaucracy of health care gets in the way.

The first responsibility for powering forward lies with the market. And developers are indeed starting to pay for rigorous studies that demonstrate the safety, efficacy and value of their technology. A cottage industry that ranks devices and apps on, say, clinical efficacy and privacy is helping doctors, insurers and governments sort good from bad.

But health-care professionals also have a vital role. Health care is a conservative industry—and rightly so, given the stakes. Yet it risks slowing the uptake of digital medicine not for legitimate concerns about safety, but because of the inertia of regulators, standards bodies, insurers and medical schools.

| *An app a day*

Rules are needed to make data ownership and use more transparent, so that people understand and control what happens with their information.

Standards can help guide developers to produce usable devices. Patients' data need to be tied into medical-record systems, which are often clunky. Practitioners need treatment protocols on how to use the new tech. Doctors must be trained and reimbursed for offering digital treatments and reviewing data. Governments and insurers must work out how to build the technology into subsidised health-care systems so busy fighting fires that they struggle to invest in prevention.

It is a long and daunting list. But the pay-off, in money and well-being, is likely to be huge. Time to roll up sleeves and prepare health care for the era of the quantified self. ■



【首文】医学

可穿戴技术有望彻底改变医疗保健

不要让官僚主义误事

这是个隐形杀手。当心脏的腔室跳动不同步时，可能会造成血液淤积和凝块。在英国每年十万余起中风里，因房颤引发的有四分之一。如果心律失常得到了治疗，这些中风大部分本可避免，但首先必须能发现它。测试成本高昂且不准确，但Apple Watch可以检测到它（Fitbits很快也可以了），价格便宜得多，可以拯救那些有风险的人。

这只是即将改变医学的一场革命的其中一例。智能手表和戒指、健身追踪器以及快速增长的各种电子增强型表带、贴片和其他“可穿戴设备”可以记录超过7500种生理和行为变量。显然，其中一些比其他的更实用，但是，正如我们将在本期技术专题中解释的那样，机器学习可以对数据洪流做筛选，展现出一幅你和你的健康的连续、量化的图景。

如今是“量化的我”的早期阶段，对于数字健康的投资者来说，这仍然是一段疯狂的旅程。看看最近提供在线医疗咨询的Teladoc股价暴跌吧，对于其他潜在的颠覆者来说，这是一个令人担忧的信号。但对于患者来说，可穿戴设备的创新才刚刚开始。具体的公司可能会浮浮沉沉，但可穿戴设备和人工智能看起来势必要在三大方面重塑医疗保健：早期诊断、个性化治疗和慢性病管理。每个方面都承诺降低成本并挽救生命。

先说早期诊断。可穿戴设备可以检测到原本不会被注意到的细微变化，从而降低疾病的严重程度并降低治疗成本。传感器将显示老年人的平衡能力是否开始变弱。早期帕金森病患者会出现步态和手臂摆动的变化。力量锻炼可以帮助预防跌倒和四肢骨折。通过跟踪智能手机的使用模式可以增强精神病学诊断，而无需监控人们看到或输入的内容。智能戒指可以通过预测月经周期来帮助女性怀孕。它还可以在受孕后不到一周的时间内检测到怀孕（许多女性在继续饮酒或吸烟几周之后才意识到自己怀孕了）。

下一个承诺是把人视为个体，而不是理论中的“普通人”的克隆。大多数药物仅对30%到50%的患者有效。有人经常吃香蕉可以降低血糖，换个人这样做，血糖会升高到长此以往会造成伤害的水平。算法可以将可穿戴设备中的海量数据转化为定制的处方和饮食，用于减肥或控制糖尿病等。这样的管理方式比一刀切的方式更有效，限制更少，因而也更容易遵循。当医生可以一直实时看到病人的身体数据时，他们可以提供更好的医疗护理。在德国的一项试验中，对心力衰竭患者的这类监测可将死亡率和住院天数降低三分之一。

可穿戴设备还可以改变糖尿病等慢性疾病。改变人们的生活方式可以预防大约80%的疾病。手机应用会利用小型设备，加上如私人教练或敏锐的配偶所采用的那种巧妙的策略，让人们运动更多、吃得更好、睡得更香。即使只是增加一点点运动也是好的：每天多走1000步（0.7公里）可将死亡率降低6%到36%，具体取决于你久坐不动的程度。持续监测也把护理的重心从医生在办公室中偶尔提供的简短咨询，转变为患者可以日复一日地为自己做的事情。美国每年为每位糖尿病患者花费一两万美元，全国每年花费约2800亿美元，达到整个公立学校预算的一半。糖尿病控制应用已被证明可以将每位患者的成本降低1400到5000美元。

所有这些好处的规模将是巨大的。至于究竟有多大，将会随着可穿戴设备创造数据并带来创新而变得更加清晰。乐观的原因是技术已经成熟。2020年售出了约二亿台设备，预计2026年售出的数字会翻一番。四分之一的美国人拥有可穿戴设备。智能手机是创新者的平台。在一两年内，你手腕上的设备可能会无创地测量你的血糖、酒精和水分，以及炎症、肾功能和肝功能的各种标志物——所有这些目前都需要抽血。随着可穿戴设备获得更多功能，用户就更不会对它们失去兴趣而将它们扔进抽屉深处。

和任何技术一样，可穿戴设备也会带来担忧。健康数据很有价值；它们可能会被那些对社会控制感兴趣的设备制造商、保险公司或政府滥用。这类技术可能无法触及穷人和生活混乱的人——恰恰是最需要它的人。但最大的担忧是医疗保健领域的官僚主义会成为阻碍。

推动进步的首要责任在于市场。而开发人员确实也已经开始为证明其技术的安全性、有效性和价值的严谨研究付费。一个给设备和应用排名（比如根据临床疗效和隐私情况）的家庭作坊式行业正在帮助医生、保险公司和政府区分好坏。

但医疗保健专业人士也起着至关重要的作用。医疗保健是一个保守的行业——考虑到所涉风险，这很有道理。然而，这可能会减缓数字医学的普及：并不是出于对安全的合理担忧，而是因为监管机构、标准机构、保险公司和医学院的惰性。

| 一天一个应用

我们需要规则来使数据的所有权和使用更加透明，以便人们了解和控制自己的信息发生什么事。设立标准可以帮助指导开发人员生产可用的设备。患者的数据需要与那些往往十分笨重的病历系统关联起来。从业者需要关于如何使用新技术的治疗方案。医生必须接受如何提供数字治疗并查看数据的培训，并获得报销。政府和保险公司必须研究如何能将这项技术嵌入受补贴的医疗系统，因为这些系统忙于到处救火，难以投资于预防工作。

这是一个冗长而令人生畏的清单。但在金钱和福祉方面的回报应该会是巨大的。是时候卷起袖子，为“量化的我”时代的医疗保健做好准备了。■



Bartleby

Why working from anywhere isn't realistic

The globe-trotting lifestyle will be open only to a lucky few

FOR MOST white-collar workers, it used to be very simple. Home was the place you left in order to go to work. The office was almost certainly the place you were heading to. Co-working spaces were for entrepreneurial people in T-shirts who wanted to hang out with other entrepreneurial people in T-shirts. You could stay at a hotel on a work trip but it was not a place to get actual work done, which is why a hotel's "business centre" defined all of business as using a printer.

The pandemic has thrown these neat categories up into the air. Most obviously, home is now also a place of work. According to a recent Gallup survey, three-quarters of American workers whose jobs can be performed remotely expect to spend time doing just that in the future. And offices are increasingly where you go to put the company into company—through collaborative work as well as through social activities.

But the boldest version of remote working extends well beyond these two locations. "Working from anywhere" envisages a completely untethered existence, in which people can do their jobs in Alaska or Zanzibar. Plenty of destinations are keen to blur the lines between business and leisure ("bleisure", the world's ugliest chunk of word-vomit). Hotels are revamping some of their rooms as offices and rolling out work-from-hotel offers. Entire countries are reinventing themselves as places to mix play and work ("plork"?): the Bahamas, Costa Rica and Malta are among those that offer visas for digital nomads.

The work-from-anywhere world edged a little closer on April 28th, when Brian Chesky, Airbnb's boss, outlined new policies for employees of the

property-renting platform. As well as being able to move wherever they want in their country of employment without any cost-of-living adjustment, Airbnb staff can also spend up to 90 days each year living and working abroad. Mr Chesky has been living out of Airbnb properties himself for the past few months, and thinks this is the future.

The idea of a globe-trotting existence sounds wonderful. Nevertheless, plenty of barriers remain. Some are practical. The legal, payroll and tax ramifications of working from different locations in the course of a year are an administrative headache (Mr Chesky admits as much, and says that he will open-source Airbnb's solution to this problem).

Mundane issues like IT support become more complicated when you are abroad. Working from anywhere is only feasible if your equipment functions reliably. If the Wi-Fi at your Airbnb reminds you of what life was like with modems, your options may be limited. If you spill suntan lotion on your laptop, the people on the hotel's reception desk are more likely to offer you sympathy than a replacement computer.

Another set of obstacles is more personal. The carefree promise of working from anywhere is far easier to realise if you don't have actual cares. Children of a certain age need to go to school; partners may not be able to work remotely and have careers of their own to manage.

The option to work from anywhere will be most attractive to people who have well-paid jobs and fewer obligations: childless tech workers, say. For many other people, the "anywhere" in working from anywhere will still boil down to a simple choice between their home and their office. That might be a recipe for resentment within teams. Imagine dialling into a Zoom call covered in baby drool, and hearing Greg from product wax lyrical about how amazing Chamonix is at this time of year.

Resentment may even run the other way. Hybrid work has already smudged the boundary between professional and personal lives. Making everywhere a place of work smears them further. Countries that used to be places to get away from it all will become places to bring it all with you. Turning down meetings when you are on a proper vacation is wholly reasonable; it is not an option when you are plorking on a jobliday. Antigua and Barbuda's tourism slogan, "The beach is just the beginning", sounds a lot more idyllic if the punchline in your head isn't, "There's also the weekly sales review".

Adding to the menu of working options for sought-after employees makes sense. Mr Chesky's new policies will probably help him attract better people to Airbnb. They are certainly aligned with the service he is selling. But for the foreseeable future, working from anywhere will be a perk for a lucky few rather than a blueprint for things to come. ■



巴托比

为何“随处工作”并不现实

这种周游世界的工作方式将仅为少数幸运儿专享

对大部分白领一族来说，一切曾经非常简单。家是上班的出发点。几乎毫无例外，办公室是目的地。联合办公空间是为那些穿着T恤的创业者能和另一些穿着T恤的创业者聚到一起而设计的。出差的时候你可以住酒店，但不会在那里完成什么实际工作，这就是为什么酒店里的“商务中心”不过就是一台打印机。

新冠疫情把这些非常清晰的空间划分全部打破了。最明显的是，现在家也是一个办公地点。盖洛普近期的一项调查显示，可以远程完成工作的美国劳动者中有四分之三预期自己未来少不了在家办公。而办公室正日益成为你通过与人协作和社交来融入人群的地方。

但最极致的远程办公模式远远超越了这两处地点。“随处工作”提出了一种完全不受约束的工作方式，人们可以在阿拉斯加或桑给巴尔完成工作。许多旅游城市正力图模糊商务差旅和休闲度假的界限（于是出现了“bleisure/商闲”这个张口就来、世上最丑的合成词）。酒店把部分房间改造成办公室，推出“在酒店办公”服务。有些国家整体转型，把自己打造成适合边玩边工作（那是不是可以叫“plork/玩工”？）的地方，巴哈马、哥斯达黎加和马耳他等国正在对数字游民发放签证。

4月28日，房屋短租平台爱彼迎的老板布莱恩·切斯基（Brian Chesky）发布了新员工政策，让“随处工作”的世界离人们又更近了一步。除了可在就业国境内随意迁居（工资不做生活成本调整），爱彼迎员工还可以每年在国外生活和工作最多90天。过去几个月，切斯基自己就住在爱彼迎的房子里过旅居生活，他认为这是未来趋势。

这种浪迹天涯的生存方式听起来很棒，但仍存在诸多障碍。有些是实际操作上的。员工一年内在不同地点工作，会带来法律、工资和税务方面的复

杂度，让行政部门头疼（切斯基承认这是个难题，并表示将“开源”爱彼迎的解决方案）。

当你身在国外，IT技术支持这类寻常问题就变得麻烦起来。只有在你的随身电子设备可靠运作的情况下，“随处工作”才是可行的。假如你租住的爱彼迎民宿内Wi-Fi的速度慢到让你仿佛置身用调制解调器上网的年代，你能做的事就很有有限了。假如你不小心把防晒露洒到了笔记本电脑上，酒店前台很可能对你深表同情，但不会给你换一台电脑。

另一类障碍是私人生活上的。没有现实牵挂的人要实现无牵无挂的“随处工作”要容易得多。孩子到了一定年龄就得考虑上学的问题；伴侣可能无法远程工作，而且也有自己的事业要安排。

“随处工作”对那些工资高、本身又不背负多少责任的人会最有吸引力，比如说没有孩子的技术员工。对其他许多人来说，随处工作的“随处”实际上还是只有家和办公室两处可选。这可能在工作团队内部滋生怨气。想象一下这样的场景，被宝宝淌了一身口水的你在家接入Zoom视频会议，却听到产品部的格雷格在大谈霞慕尼（Chamonix）此时此刻多么美好惬意。

怨气甚至还可能倒过来。混合工作模式已经模糊了职业和个人生活间的界限。到处都能办公的理念进一步抹掉了这个界限。以往为逃离一切工作而前往的国家现在成了要带着所有工作前去的国家。在真正度假时，拒绝参加工作会议是完全合理的，但如果你是在“jobliday/工作假”里“玩工”，那就不行了。安提瓜和巴布达的旅游宣传口号“海滩只是个开头”听起来很诗情画意，前提是你脑子里不会接上一句“还有每周的销售总结”。

为抢手的员工提供更多工作方式的选择是有道理的。切斯基的新政策可能帮助他吸引到更优秀的人才加入爱彼迎。这些政策当然也与他销售的服务一脉相承。但在可预见的未来，“随处工作”将是少数幸运儿的福利，而非多数人的蓝图。■



The Economist Film

Sustainable materials: is there a concrete solution? (Trailer)

11% of the world's carbon emissions come from construction, with concrete being the biggest culprit. How can we continue to build, without it costing the earth?



经济学人视频

绿色建材：混凝土能否减排？（预告片）

全球人类活动造成的碳排放有11%来自建筑业，混凝土又是最大排放源。新型建筑能否变得更环保？



Out, dammed spot

A sound way towards reversible vasectomies

Researchers test a means to block—and neatly unblock—men’s reproductive ductwork

THE MOST reliable means of contraception for men—and one that cannot fail or be forgone in the heat of the moment—is a vasectomy. But the procedure is largely irreversible: it involves stopping the flow of sperm from the testes by cutting conduits known as the vas deferens and sealing them or tying them off. A reconnection, after a reconsideration, is no small task.

Researchers are now examining a different tack: blocking the vas deferens using compounds that combine to form a barrier that can later be removed. Lab trials have involved four separate injections to establish a sperm-proof barrier, which could later be dissolved using a blast of focused, infrared light.

Aware that repeated injections into the penis might affect men’s willingness to undergo such a procedure, Wanhai Xu, a urologist at Harbin Medical University in China, and colleagues propose a different idea: a barrier that can be put in place with one injection and broken down with ultrasound.

Dr Xu’s recipe includes three parts, principally a polymer known as a hydrogel that thickens inside the body and is already approved for medical use. Crucially, in that gel were plenty of thioketals, compounds that fall apart when exposed to reactive, oxygen-containing molecules, plus just a sprinkle of titanium dioxide—an inert material that, when exposed to ultrasound, releases just those molecules.

To check their work, Dr Xu’s team employed a few dozen male rats. Some

were given a traditional vasectomy, others an injection of the new material and the rest injected with saline, as a control. Each was then permitted to follow its essential nature with four females. Only those rats given the saline sired offspring.

The real test, as the team reports in ACS Nano, a nanotechnology journal, came next: half the rats given the new treatment were exposed to a blast of ultrasound. That evidently dissolved the hydrogel in the creatures' pipes: they could again reproduce, while those not thusly blasted stayed sterile.

What works in rats, alas, does not always work in humans, so further trials will be needed. But Dr Xu is hopeful that these findings represent a sound idea for a reversible contraceptive—with fewer sticking points. ■



拆坝

一个实现可逆输精管结扎的好办法

研究人员测试一种阻断男性生殖管道以及轻松解除阻断的方法【新知】

最可靠的男性避孕手段——要万无一失且不会在激情时刻弃之不用——就是输精管结扎术。但这种手术基本是不可逆的：它切断了输精管并把切口封闭或结扎，从而阻止精子从睾丸流出。如果改主意了，要再接通可不容易。

研究人员正在研究一种新的结扎术：用化合物结合成屏障阻断输精管，而这种屏障日后可以移除。在实验室试验中，化合物分四次注射以形成隔绝精子的屏障，之后可使用聚焦红外光束溶解。

考虑到反复向阴茎注射化合物可能会影响男性接受手术的意愿，哈尔滨医科大学的泌尿外科医生徐万海及其同事提出了不同的思路：一种只需注射一次并能通过超声波清除的屏障。

徐万海的配方包括三个部分，其中最主要的是—种名为“水凝胶”的聚合物，它能在人体内凝固，已经获准用于医疗。很关键的是，这种凝胶中含有大量缩硫酮和少量二氧化钛（一种惰性物质），前者遇活性含氧分子会分解，后者遇超声波就会释放出活性含氧分子。

为验证设计，徐万海的团队在几十只雄性大鼠身上做了实验。一部分雄性大鼠接受传统输精管结扎术，另一些注射这种新的水凝胶材料，其余的注射生理盐水作为对照组。然后让每只雄性大鼠与四只雌性大鼠交配。最后只有那些注射了生理盐水的大鼠成功繁殖了后代。

真正的测试还在后头。该团队在纳米技术期刊《ACS纳米》（ACS Nano）上介绍道，接下来，研究人员用超声波束照射半数接受了新结扎术的大鼠。这显然溶解了这些动物的输精管中的水凝胶，因为它们又能繁殖了，而那些没接受照射的大鼠仍然无法生育。

可是，在大鼠身上行之有效的方法不总对人类有效，因此还需要进一步的试验。但徐万海有信心他的研究成果体现了可逆避孕的一种好思路——里头的缠结点更少了。■



Human space flight

Spacesuits are showing their age

Astronauts' wardrobes are in need of a makeover

FIXING PANELS on the International Space Station (ISS) is a bit like doing car repairs while wearing stiff oven gloves and standing on a skateboard. That, at least, is the way Kate Rubins, an astronaut at NASA, America's space agency, describes it. And she has spent 300 days orbiting Earth on board the station, so she should know.

Today's bulky spacesuits weigh (or, for pedants, have a mass that is) nearly a third more than those sported by the Apollo astronauts who walked on the Moon in the 1960s and 1970s. To complicate matters further, the free fall of orbit lacks the dampening effects on Newton's first and third laws of motion (things move for ever unless acted on by a force, and every action results in an equal and opposite reaction) which are offered by the Moon's gravitational field and solid surface. Spacewalkers must therefore think far more carefully about the consequences of their actions than Moonwalkers need to.

Add in the fact that most systems in spacesuits used today were designed in the early 1980s, giving plenty of time for their flaws to become apparent (in 2013, for example, an Italian astronaut on the ISS nearly drowned when more than a litre of cooling water pooled inside his helmet). Add further that NASA hopes to return astronauts to the Moon at some point in the 2020s and it is clear the time has come for an upgrade. NASA has a long list of features it would like to modify or add. But Chris Hansen, head of extravehicular activity at the agency, says the immediate objective is to develop suits that permit far more body movement than the rigid ones which, as he puts it, had Apollo Moonwalkers "hopping around like bunnies and falling over".

| *Tailoring away*

NASA's quest for new suit designs has not, however, gone well. In August 2021 Paul Martin, its inspector-general, concluded that 14 years and \$420m had been spent for meagre results. Mr Martin also said that despite NASA's intention to double that sum over the following few years, it would still not produce spacesuits in time for a Moon landing that was then planned for 2024 (and now delayed to 2025). So, learning yet again a lesson that it really ought to have taken on board by now, the agency is farming out suit design to the private sector. The idea is to come up with something that can be adapted for use both in orbit and on the lunar surface. The winner will be announced this month.

As Dr Hansen's remarks foreshadow, an important criterion of success in this competition will be a spacesuit's flexibility. One contender is Astro, a suit proposed jointly by three firms: Collins Aerospace, of Charlotte, North Carolina; ILC Dover, of Newark, Delaware; and Oceaneering, of Houston, Texas. Astro makes extensive use of Vectran, a synthetic fibre tougher than the Kevlar employed in bulletproof garments. This is made using a liquid-crystal polymer that confers both strength and the necessary flexibility.

Wearers of such a suit should be able to reach up and bend down, gestures that would be impossible in today's spacesuits. According to Dan Burbank, a former astronaut who helped assemble the ISS in orbit and who is now a technologist at Collins, they could even perform press-ups, at least when gravitationally bound to the surface of the Earth.

A version of Astro designed for Moonwalks would allow treks of perhaps 10km, a distance that dwarfs those managed by Apollo astronauts. This lunar hiking kit would be fitted with special boots and a "breadcrumb-trail" display on its face shield to show the occupant where he or she had been—and thus, crucially, how to get back home.

For spacewalks in Earth orbit, however, some people question the need for suits at all. Instead, they propose miniature spacecraft fitted with thrusters and robotic arms. Genesis Engineering Solutions, a firm in Maryland, is going down this route with what it calls the Single-Person Spacecraft (SPS). The thrusters use compressed nitrogen—though, in an emergency, they could also tap into the craft’s air tanks. The arms were originally designed for defusing bombs, making them far more dexterous than an astronaut’s gloved hand; they can be controlled either by the spacewalker or by a remote operator. If all goes well the SPS will be used on Orbital Reef, a commercial space station being built by firms including Blue Origin and Sierra Space, and scheduled for launch in the late 2020s.

The SPS, Genesis believes, offers several advantages over conventional spacesuits. For one thing, no airlock is needed to permit entry to and exit from a space station. Instead, the craft docks directly with the station, so the two share their air until the hatches between them are closed. That means a pilot can shimmy in and out of an SPS with little fuss. In contrast, for a suited spacewalker to leave and return to the mothership requires an airlock to be pumped down for exit and then pumped up for re-entry. Given that pumping down is never completely efficient, this inevitably leaks part of a station’s air supply.

Another key difference is that a spacecraft can operate at atmospheric pressure. Pressurising a suit to this extent, however, increases its rigidity, making its gloves in particular so stiff as to be useless for manual tasks. The pressure inside a spacesuit is therefore normally held at about one-third of an atmosphere. But this would not deliver enough oxygen for an astronaut to breathe if standard air were used. So pure oxygen is employed instead.

One consequence of that pressure drop is a risk of decompression sickness, in which nitrogen gas emerges from the bloodstream in painful and dangerous bubbles. So before suiting up spacewalkers must undergo a so-

called pre-breathe of pure oxygen to purge the blood of nitrogen. A pure-oxygen atmosphere is also a fire hazard. That is not a theoretical risk. Three Apollo astronauts were killed by fire in a ground test in 1967 because their capsule contained such an atmosphere.

Spacesuits bring a third safety hazard, too, according to Brand Griffin, who leads the SPS effort at Genesis. He says that the shielding on an SPS provides protection against fast-moving debris and micro meteoroids that would puncture a suit. Were this to happen, the vacuum of space would cause the astronaut's body fluids to vaporise. And yet another advantage of a spacecraft is that, if a pilot were somehow incapacitated, its thrusters could be remotely controlled and docked with the mothership more easily than a spacewalker could be hauled back into an airlock.

The downside to miniature spacecraft is price. An SPS will, according to Genesis, cost nearly \$70m—around four times the price of a spacesuit. But lower running costs may compensate for such upfront expenditure. With tasks including adjusting a suit to the astronaut who will wear it (for they are not bespoke items), donning and doffing it, and sterilising its interior after use, a single spacewalk requires about 63 hours of labour on board the ISS, not counting the excursion itself. For an inkling of the expense involved in this, consider that the charge-out rate for a NASA astronaut's services on the ISS is \$130,000 an hour. Blue Origin, the moving spirit behind Orbital Reef, reckons that, once such costs are factored in, an SPS will end up being the cheaper option.

Suited spacewalks are, in any case, so dangerous that NASA is discouraging the operators of planned commercial space stations like Orbital Reef from engaging in them. As for space tourists, extravehicular outings have always been out of the question, no matter how dazzling the experience would be. The SPS will change that, says Brent Sherwood, Blue Origin's head of advanced development programmes. He foresees "tourist-proof",

automated excursions as part of package holidays in space.

| *Haute couture*

Even if it works as intended, though, the SPS will not end the need for spacesuits. Gateway, a lunar-orbiting international space station, the assembly of which is planned to start sometime after November 2024, has been designed for outings from it to happen in suits, not single-astronaut spaceships. Orbital Reef will, for its part (and despite NASA's scepticism), support suited spacewalks as well as the SPS. That system, after all, has yet to prove itself.

Moreover, spacesuit technologists have other ideas up their sleeves. ILC Dover, for example, plans to simplify suited spacewalking by delivering life support via an umbilical cord. This would limit mobility but cut costs sharply, says Dan Klopp, head of business development at the firm. "Suitports" are also promising. With these, an astronaut would climb into the back of a spacesuit attached to the outside of a vehicle. After the spacesuit and vehicle had been sealed, the suit could be detached with no airlock required, as with the SPS.

Hovering over all of this, it should be acknowledged, is the question of whether spacewalks and Moonwalks by people actually achieve anything that robots (either remotely controlled or fully autonomous) cannot. To ask that, though, is to challenge the whole reason for crewed space flight. And that would never do, would it? ■



载人航天

宇航服太过老旧了

宇航员的衣柜需要来一次大更新【新知】

维修国际空间站上的太阳能电池板有点像戴着硬挺的烤箱手套站在滑板上修理汽车。至少，美国国家航空航天局（NASA）的宇航员凯特·鲁宾斯（Kate Rubins）是这样描述的。她已经在空间站上绕地球飞行了300天，应该深有体会。

比起上世纪60年代和70年代阿波罗载人登月之时，如今臃肿的宇航服的重量（要抠字眼的话，应该说是质量）多了近三分之一。把事情变得更复杂的是，轨道上的自由落体环境没有月球的引力场和固体表面对牛顿第一和第三运动定律（除非受到外力，否则物体运动速度不变；一个作用力必然产生一个大小相等、方向相反的反作用力）的消减作用。因此，比起在月球上行走，人在太空行走时对自己行动后果的考量必须得审慎得多。

再加上现在的宇航服所用的大多数系统都是上世纪80年代初设计的，经过这么长的时间，它们的缺陷都已经暴露了出来（例如在2013年，国际空间站上的一名意大利宇航员的头盔里灌入了超过一升的冷却水，差点把他淹死）。另外，NASA希望在本个十年里让宇航员重返月球，显然是时候升级改造宇航服了。NASA想要修改或添加的功能有一长串，但它的舱外活动主管克里斯·汉森（Chris Hansen）表示，眼前的目标是开发出能让人做多得多的肢体动作的宇航服。如他所说，以前那种僵硬的宇航服让阿波罗号的宇航员在登月时“像兔子一样跳来跳去，还容易摔跟头”。

| 大改特改

然而，NASA对宇航服新设计的探索并不顺利。2021年8月，其监察长保罗·马丁（Paul Martin）得出结论称，14年来4.2亿美元的投入成效甚微。马丁还表示，尽管NASA打算在接下来的几年里把投入翻番，仍然无法及时为当时计划在2024年实现（现在延后到2025年）的登月行动生产宇航服。就这样，NASA在一个它早该吸取的教训上再一次摔了跟头。它现在

把宇航服设计外包给了私营部门。它希望拿到一个可以在轨道作业和月球表面行走中调整切换使用的设计。中标设计即将在本月公布。

正如汉森的话所预示的那样，在本次竞标中，一个重要的选择标准将是宇航服的灵活性。其中一个竞标设计是Astro，它由三家公司联合推出，分别是北卡罗来纳州夏洛特市的柯林斯航空航天公司（Collins Aerospace）、特拉华州纽瓦克市的ILC Dover，以及德克萨斯州休斯顿的Oceanering。Astro大量使用了一种名为Vectran的合成纤维，比防弹服中所用的凯芙拉（Kevlar）更坚韧。这种纤维由液晶聚合物制成，既具强度又有所需的柔性。

穿着这种宇航服，宇航员应该能够自如地向上伸手和弯腰，这些动作都是穿着现在的宇航服无法做到的。柯林斯公司的技术专家丹·伯班克（Dan Burbank）曾作为宇航员在地球轨道上参与组装国际空间站，他说穿着这种新设计的宇航服甚至可以做俯卧撑，至少在有重力作用的地球表面上是这样。

Astro宇航服有一款为登月设计的型号，让穿着它的宇航员可以跋涉大约10公里，远远超出阿波罗宇航员的行走距离。这款月球远足宇航服将配备一双特殊的靴子，其面罩上将安装有显示“面包屑路径”的显示器，向宇航员展示他或她途经的路线，也就能显示该如何返回——这一点至关重要。

然而，对于在地球轨道上的舱外活动，一些人质疑是否一定要用到宇航服。他们提议改用配备推进器和机械臂的微型航天器。马里兰州的Genesis Engineering Solutions公司正在按这个方向开发它称之为单人航天器（Single-Person Spacecraft，以下简称SPS）的设备。这套设备的推进器使用压缩氮气，但在紧急情况下也可以利用航天器上的储气罐。它的机械臂原本是为拆除炸弹而设计的，比宇航员戴着手套的手要灵巧得多，可以由宇航员或远程操作员来操控。如果一切顺利，SPS将被部署到蓝色起源（Blue Origin）和Sierra Space等公司正在联合建造的商业空间站Orbital Reef上，该空间站计划于2020年代末发射。

Genesis认为，SPS与传统宇航服相比具有多项优势。一方面，SPS进出空间站不需要气闸舱，而是直接与空间站对接；除非两者间的舱门关闭，否则它们的空气是流通的。这意味着宇航员不用大费周章就可以钻进和钻出SPS。相比之下，如果穿着宇航服出舱，宇航员离开和返回空间站时都需要经过气闸舱，离开时要减压，返回时要加压。由于做到无法百分百减压，空间站里的空气供给会不可避免地有所泄漏。

另一个关键差别是航天器可以在大气压下运行。而如果把宇航服加压到大气压，它会变得更加僵硬，尤其是手套的部分将根本无法开展手动作业。因此，宇航服内的压力通常保持在大气压的三分之一左右。但是，在这种压力下，普通空气无法为宇航员的呼吸提供足够的氧气，所以要用纯氧代替。

压力下降的一个后果是可能出现减压症，氮气会在血液中形成气泡，叫人痛苦且危险。因此，在套上宇航服前，宇航员必须做预吸纯氧的操作，以清除血液中的氮。纯氧环境也带来了火灾隐患。这可不只是理论上的风险。在1967年的一次地面测试中，三名阿波罗宇航员被大火烧死，当时舱内的气体就是纯氧。

宇航服还有第三个安全隐患，在Genesis负责SPS项目的布兰德·格里芬（Brand Griffin）指出。他说，快速移动的太空碎片和微流星体能够刺穿宇航服，而SPS的外壳能起到防护作用。宇航服一旦被刺破，太空的真空状态会导致宇航员的体液蒸发。SPS的另一个优点是，如果宇航员因某种原因丧失了行动能力，可以远程控制推进器并与空间站对接，这要比把宇航员拖回气闸舱更容易。

微型航天器的缺点是价格高。据Genesis称，一台SPS的价格近7000万美元，约是一套宇航服的四倍。但它的运行成本较低，可能会弥补这种前期支出。宇航员每一次出舱，在国际空间站上的准备工作就要花费大约63小时，包括根据身形调整宇航服（因为宇航服不是定制的）、穿脱宇航服、以及每次使用之后对其内部做消毒等，这还不包括太空行走本身的时间。要大概了解这个过程的费用，看看NASA宇航员在国际空间站上每小时13

万美元的标准服务收费就知道了。策划Orbital Reef项目的蓝色起源认为，如果把这些成本考虑在内，最终还是SPS更划算。

无论如何，穿着太空服出舱非常危险，所以目前NASA不赞同Orbital Reef等计划中的商业空间站的运营商开展这项活动。对于太空游客来说，舱外活动从来都不在可选项之列，无论它会是多么令人眼花缭乱的体验。蓝色起源的高级开发项目负责人布伦特·舍伍德（Brent Sherwood）表示，SPS将改变这一点。他预期，未来的太空旅行套餐将包括“保证游客安全”的自动化太空行走。

| 高级定制

不过，即使SPS能达成设计目标，也不会终结对宇航服的需求。月球轨道国际空间站Gateway计划于2024年11月之后的某个时间开始组装，它的设计就是让人们穿着宇航服出舱，而不是乘坐单人太空飞船。至于Orbital Reef，它将既支持乘SPS出舱也支持穿宇航服（尽管NASA持怀疑态度）。毕竟，SPS尚需验证。

此外，宇航服技术专家们也有自己的设想。例如，ILC Dover计划通过脐带式系绳提供生命支持来简化穿宇航服的舱外活动。该公司业务发展主管丹·克洛普（Dan Klopp）表示，这将限制宇航员的活动，但会大幅削减成本。“宇航服舱口”也很有前景。有了这样的舱口，宇航员就可以从底部爬进一套从舱外和飞行器连接的宇航服里。待宇航服和飞行器双双密闭后，就可以断开连接，整个过程和SPS一样用不到气闸舱。

不得不提的是，在这一切之上有一个问题，就是人类的太空行走和月球行走是否真能做到什么（远程控制或完全自主的）机器人无法完成的事。不过，问这个问题就是在挑战载人航天的全部逻辑了。那可绝对行不通，是不是？ ■



Feeling the heat

In chilly parts of Europe, heatwaves strengthen environmentalism

Support for green parties rises following unusually warm years

THE BIGGEST obstacles to slowing climate change are political. Although carbon emissions can be slashed with current technologies, such cuts are perceived to require sacrifices today in order to reduce the risk of calamity in future. Many voters refuse to shoulder these costs.

Global temperatures are already rising fast. Even if today's weather extremes may look mild by future standards, they are still more severe than those of the past. In theory, unusual weather events like dry or warm spells might have a silver lining: providing a wake-up call to complacent voters. A recent paper by Roman Hoffmann, Raya Muttarak and Jonas Peisker of IIASA, a think-tank, and Piero Stanig of Bocconi University finds evidence for this pattern, with a caveat. It shows up mostly in rich countries with cool climates.

To test the link between weather and environmentalism, the authors compiled data on wildfires, droughts, floods and temperatures in 1,239 European administrative areas in 1994-2019. They also tracked two measures of public concern about the environment: responses from a long-running European survey, and the performance in European Parliament elections of green parties, whose voters tend to be particularly focused on climate change.

The researchers found that unusual weather, particularly in the form of heat, did focus people's minds on climate. The more unseasonably warm days (when compared with the average in 1971-2000) in a given region during the year preceding a poll or European election, the more people in that area said that they were concerned about the environment, and the

greater the share of votes green parties went on to win. The same was true of droughts, and to a lesser degree of wildfires.

The impact of other types of weather was much less clear. Cold snaps did seem to help green parties, but to a lesser degree. Extreme wet periods had little effect. And green parties may in fact have fared worse in elections following floods (though further study is needed to confirm this effect).

The authors speculate that use of the specific term “global warming” rather than the broader “climate change” may prevent the public from attributing weather events other than heatwaves or droughts to human activity.

Another study found a similar discrepancy in America: hot, dry days raised the chances that poll respondents said they believed in climate change, but floods and low temperatures did not.

Even high-temperature episodes do not consistently strengthen environmentalism. Instead, the effect is limited to specific contexts. It is greatest in the temperate and colder regions of northern and western Europe, and mostly absent in the arid Mediterranean basin. One possible explanation is that southern Europeans are already used to hot weather, and may be less perturbed by extreme heatwaves. They are also more likely to have air conditioning.

Another source of variation is income. In rich parts of the eu, such as Brussels, votes for green parties tend to surge following high temperatures. No such increase occurs in poor areas like western Bulgaria, where green parties are uncompetitive regardless of recent weather. For families struggling to put bread on the table, worrying about the fate of the planet decades hence might seem like a luxury.

Source: “Climate change experiences raise environmental concerns and promote green voting”, by R. Hoffmann et al., Nature Climate Change, 2022 ■



感受热浪

在欧洲的凉爽地区，热浪强化了环保主义

在经历异常温暖的年份后绿党的支持率会上升

减缓气候变化最大的障碍是政治上的。尽管目前的技术可以大幅削减碳排放，但人们认为这样的削减要求在今天做出牺牲，以减少未来发生灾难的风险。许多选民拒绝承担这些代价。

全球气温已经在迅速上升。即便今天的极端天气以未来的标准衡量可能还算温和，但仍然比过去要严重。理论上，像干旱或温暖期这样的异常天气事件可能尚有一丝好处：给安于现状的选民敲响警钟。最近一篇由智库国际应用系统分析研究所（IIASA）的罗曼·霍夫曼（Roman Hoffmann）、拉亚·穆特拉（Raya Muttarak）、乔纳斯·佩斯可（Jonas Peisker）以及博科尼大学（Bocconi University）的皮耶罗·斯坦尼格（Piero Stanig）共同撰写的论文发现了这样的效应，不过有个补充说明。这样的影响主要出现在气候凉爽的富裕国家。

为了测试天气和环保主义的关联，几位作者汇集了1994年至2019年间欧洲1239个行政区域的野火、干旱、洪水和气温的数据。他们同时追踪了两项反映公众对环境的关注度的指标：欧洲一项长期民调的结果；绿党在欧洲议会选举中的表现，它们的选民往往特别关注气候变化。

研究人员发现，异常天气，尤其是高温，确实会让人们关注气候问题。一个地区在接受民意调查或欧洲议会选举的前一年反常暖和的天数越多（与1971年至2000年间的平均温度相比），那里就有越多的人表示自己担忧环境，而接下来绿党赢得的选票份额也越多。出现异常干旱天气时也是如此，而野火的关联程度要低一些。

其他天气状况的影响远没有这么明确。寒流似乎确实有利于绿党，但程度较轻。极端潮湿期的影响微乎其微。而在洪水过后的选举中，绿党的表现甚至可能更糟了（尽管还需要进一步的研究来证实这一效应）。作者们推

测，使用更具体的“全球变暖”的字眼而不是更宽泛的“气候变化”可能会影响公众，让他们认为热浪或干旱以外的天气事件不是人类活动的结果。另一项研究发现美国也有类似的差异：炎热、干燥的天气提升了调查受访者相信气候变化确有其事的几率，洪水和低温却没有。

即使是高温天气也不总是会强化环保主义。这种影响仅限于特定条件。它在北欧和西欧的温带和较寒冷地区最为明显，而在干旱的地中海盆地很少出现。这可能是因为在南欧人已经习惯了炎热天气，不会为极端热浪多么困扰。他们已经安装空调的几率也更高。

另一个差异源头是收入。在欧盟的富裕地区，比如布鲁塞尔，投给绿党的选票往往会在高温天气后激增。而像保加利亚西部这样的贫困地区则没有这样的增长：不管近期天气如何，绿党在当地都没有竞争力。对忙于养家糊口的家庭来说，担心几十年后地球的命运可能是一种奢侈

资料来源：《经历气候变化提升了人们对环境的关注，促使他们为绿党投票》，R.霍夫曼等著，《自然气候变化》期刊，2022年■



Palm roiled

The war in Ukraine is rocking the market for edible oils

Consumer-goods giants risk going hungry

WHEN VLADIMIR PUTIN'S tanks rolled into Ukraine in late February, crude-oil markets reacted instantly to the uncertainty and, in short order, to the sanctions imposed on Russia, the world's second-biggest exporter of the black stuff. The war's impact on another set of crucial oils—the edible vegetable fats such as sunflower oil, of which Ukraine and Russia are the world's two biggest exporters—has taken longer to digest. It is now causing heartburn for the consumer-goods giants that use them by the tonne to make everything from snacks to lipstick.

Exports from war-torn Ukraine have all but stopped. Russia has placed an export quota on its sunflower oil. Worries about scarce supplies have led countries including Egypt and Turkey to ban exports of edible oils. And from April 28th Indonesia has banned exports of palm oil, another widely traded variety.

The archipelagic country sold \$18bn-worth of the stuff abroad in 2020, accounting for half of all palm-oil exports. So the move sent prices, which had dipped after the initial war-induced spike, soaring again (see chart). A tonne of palm oil for delivery in May is trading at over \$1,700, 70% higher than the average spot price in 2021. This is piling more inflationary pressure on global producers of consumer goods—and sabotaging their environmental bona fides.

Unilever, a soap-to-soup group, spent \$2.7bn on palm oil last year, around 15% of its total spending on commodities. Procter & Gamble, a similarly sprawling giant, and big packaged-goods firms like Mondelez and Nestlé are in a similar pickle. Everyone is paying more for soyabean and other

alternative oils, too, so substituting one kind for another would bring little financial relief. Investors typically view the big consumer firms as being resilient to economic shocks. But as input prices rise some may be beginning to doubt the companies' ability to pass on the extra costs to shoppers, who are becoming fed up with rising bills.

The ban, which does not have a specified end date, will also complicate the companies' efforts to present themselves as environmentally responsible. Palm-oil production has historically often come at the expense of rainforests, which were razed in places like Indonesia to make room for plantations. Today Nestlé says that 90% of the palm oil it purchased in 2021 was certified as deforestation-free, thanks to close monitoring of supply chains, from the plantation to the port. Such capacity has taken years to develop in Indonesia and will be hard to replicate elsewhere at short notice. If the Swiss giant and its rivals have to resort to buying oils from more opaque places, that could leave a greasy stain on their carefully manicured green reputations. ■



翻腾的棕榈油

俄乌战争冲击食用油市场

消费品巨头面临缺油危机

普京的坦克在2月底开进乌克兰，原油市场即刻对前景的不确定性做出反应，而后又很快对全球第二大原油出口国面临制裁做出反应。而对于这场战争对另一类关键油品的影响，人们则花了更长时间来消化，那就是葵花籽油等食用植物油，乌克兰和俄罗斯是这类油的两个最大出口国。眼下，大量使用这些油来制造从零食到口红等各种产品的消费品巨头心焦不已。

遭受战争蹂躏的乌克兰已近乎停止出口食用油。俄罗斯对葵花籽油设定了出口配额。由于担忧供应短缺，埃及和土耳其等国已禁止出口食用油。从4月28日开始，印尼禁止出口棕榈油，这是另一种广泛交易的食用油。

这个群岛国家在2020年出口了价值180亿美元的棕榈油，占到全球出口总额的一半。俄乌战争爆发后，棕榈油的价格先是飙升，然后回落，但印尼的出口禁令让价格再次暴涨（见图表）。5月交货的棕榈油交易价格超过每吨1700美元，比2021年的平均现货价格高70%。这给全球消费品生产商带来了更多的通胀压力，也对它们的环保诚意形成考验。

生产从肥皂到速食汤等各类消费品的联合利华去年花27亿美元购买棕榈油，约占它在大宗商品上的总支出的15%。产品种类同样繁多的消费品巨头宝洁，以及亿滋和雀巢等大型包装食品公司也陷入了类似的困境。各家公司也在为大豆等替代油支付更多钱，所以用一种油取代另一种也不会缓解多少财务压力。投资者通常认为大型消费品企业能够承受经济冲击。但随着投入品的价格上涨，一些人开始怀疑这些公司能否把增加的成本转嫁给消费者，毕竟民众已经开始对账单数字上涨怨声载道。

印尼的出口禁令没有明确的结束日期，也将令这些公司打造对环境负责的自我形象的努力变得复杂。历史上，棕榈油的生产往往以牺牲热带雨林为代价，印尼等地的大片雨林被夷为平地以改种棕榈。今天，雀巢声称它在

2021年购买的棕榈油中有90%都带有“零毁林”认证，实现这一点靠的是密切监控从种植园到港口的供应链。而这样的产能经过了多年努力才在印尼建立起来，短时间内很难在其他地方复制。假如这家瑞士巨头及其竞争对手被迫从运作更不透明的产地买油，它们精心打造的环保招牌也许会沾上油腻的污点。 ■



Crossing the chokepoint

America has a plan to throttle Chinese chipmakers

It will deny them tools to do the job

MAKING CHIPS is complex work. Semiconductor manufacturers such as Intel, Samsung and TSMC themselves rely on machine tools built by an array of firms that are far from household names. The equipment sold by Applied Materials, Tokyo Electron, ASML, KLA and Lam Research is irreplaceable in the manufacture of the microscopic calculating machines that power the digital economy. A supply crunch, coming after years of ructions between America and China over control of technology, has made governments around the world more aware of the strategic importance of chipmaking. The significance of the kit used to make chips is now being recognised, too.

Such tools handle the complex processes of scratching billions of electric circuits into a silicon wafer. Those circuits shuttle electrons to do the calculations that display this article on a screen, plot your route across town or allow your fingerprint to unlock your phone. They must be perfect. KLA makes measurement tools which are essentially electron microscopes on steroids, scanning each part of a finished chip automatically for defects and errors. Some Lam Research tools are designed to etch patterns in a silicon wafer by firing beams of individual atoms at its surface. Applied Materials builds machines which can deposit films of material that are merely a few atoms thick.

The Chinese government's efforts to develop a large and advanced semiconductor industry at home using these mind-boggling technologies have led to a rapid shift in the source of the revenues for the firms making it over the past five years. In 2014 the five main toolmakers sold gear worth \$3.3bn, 10% of the global market, to China. Today the country is their

largest market by a significant margin, making up a quarter of global revenues (see chart). Of the \$23bn in sales for Applied Materials, the largest equipment-maker, during its latest fiscal year, \$7.5bn came from China. It accounts for over a third of Lam Research's revenues of \$14.6bn, the largest share of any big toolmaker (though the firm notes that some portion of Chinese sales are made to multinational firms that operate there).

This new reliance has created political and commercial problems, particularly for the trio of American toolmakers: Applied Materials, KLA and Lam Research. The Chinese government has thrown hundreds of billions of dollars at domestic chipmakers. Because each of the American trio is dominant at a different step of the process, the unavoidable conclusion is that America's most advanced technology is furthering China's economic goals. There is strong bipartisan agreement in Washington that this is unacceptable.

America's government has long sought solutions to this uncomfortable problem. In December 2020 it placed SMIC, China's leading chipmaker, on an export blacklist. Any American company wishing to sell products to SMIC had to apply for a licence. But tools have kept flowing to the Chinese firm, in part because America acted alone. The Chinese government's lavish subsidies have instead started finding their way to non-American competitors. Applied Materials noted that this might help other firms as, in effect, shutting it out of China "could result in our losing technology leadership relative to our international competitors".

The problem is becoming more acute. SEMI, the global semiconductor-tooling trade body, announced on April 12th that worldwide industry revenues from China grew by 58% in 2021, to \$29.6bn, cementing its place as the world's largest market. Political pressure is rising. In March two Republican lawmakers wrote to America's Department of Commerce demanding a tightening of export controls on chip technology going to

China, specifically mentioning chipmaking equipment.

China's appetite for chipmaking tools is also causing commercial difficulties for non-Chinese chipmakers, depriving them of equipment and hence the capacity to manufacture chips. On April 14th C.C. Wei, the boss of TSMC, said the Taiwanese firm had encountered an unexpected "tool delivery problem" that threatened its ability to make enough chips. Though he did not blame China, chip-industry insiders say it is the likely cause. TSMC has warned Apple and Qualcomm, two of its largest customers, that it may not be able to meet their demand in 2023 and 2024, according to two independent sources.

Over the past four months the American toolmakers have started working with the government, through Akin Gump, a firm of lawyers and lobbyists based in Washington, DC, to find a way round the problem. The toolmakers formed the Coalition of Semiconductor Equipment Manufacturers late last year to further that aim, using Akin Gump to represent them. Lawyers have been poring over the products of Applied Materials, Lam Research and KLA in an attempt to identify workable export controls under which less advanced pieces of equipment that are not used for cutting-edge manufacturing might still be sold to China, while more advanced tools would be prohibited. That would allow the toolmakers to retain some portion of their Chinese revenues.

Efforts to figure out where to draw the line continue. Akin Gump has been lobbying cabinet members and legislative leaders on behalf of the coalition, and is in ongoing discussions with both the Biden administration and members of Congress. "The plan is being driven by the Biden administration," the Coalition said in a statement on April 25th.

The proposal hinges on getting America's allies—in particular Japan and the Netherlands, home to Tokyo Electron and ASML—to impose the same

export controls on their toolmakers. The chances of this have increased since Russia's assault on Ukraine. Officials around the world have been regularly putting their heads together to understand the effect America's bans on trade with Russia will have on their countries. That has created channels through which the complex task of shutting China out of advanced chipmaking, a far trickier task than curbing sales of oil or weapons, might take place.

The plan may yet fall apart. China is unlikely to accept it meekly. Hawks in Washington may push for harder restrictions. Defining what equipment can continue to be exported to China may prove too difficult. But if it works, Chinese chipmakers would need decades to catch up with the West—and America would have met its goals of suppressing Chinese semiconductor development while causing minimal harm to its own industry. ■



突破瓶颈

美国有一个掐中国芯片厂商脖子的计划

它会让中国失去制造工具

芯片制造是一项复杂的工作。英特尔、三星和台积电等半导体制造商本身也要依赖一些公司生产的设备，而这些公司远非家喻户晓。在制造驱动数字经济的这种微型计算机器方面，应用材料（Applied Materials）、东京电子（Tokyo Electron）、阿斯麦（ASML）、科磊（KLA）和泛林集团（Lam Research）这五大公司销售的设备具有不可替代的作用。中美两国这些年来围绕技术控制权纷争不断，随之而来的供应短缺已经让世界各国政府更加意识到芯片制造的战略重要性。如今，芯片制造设备的重要性也逐渐被各方所认识。

这类设备负责复杂的生产工艺，把数以十亿计个电路刻到硅片上。这些电路通过传输电子开展运算，你因而能在屏幕上看到本文，为穿越城镇导航，或者用指纹解锁手机。它们必须做到万无一失。科磊生产的测量设备实质上是超级版的电子显微镜，它能自动扫描成品芯片的每一部分，看是否存在缺陷和差错。泛林集团的一些设备可以通过向硅片表面发射一束束原子在硅片上蚀刻图案。应用材料生产的设备可以沉积只有几个原子厚的材料薄膜。

过去五年里，随着中国政府力求用这些高尖技术在本国发展出一个庞大而先进的半导体产业，制造这些设备的公司的收入来源发生了急剧变化。2014年，这五大主要设备制造商向中国销售了价值33亿美元的设备，占全球市场的10%。如今，中国以明显优势成为它们最大的市场，占到它们全球总收入的四分之一（见图表）。全球最大的设备制造商应用材料上一财年的销售额为230亿美元，其中75亿美元来自中国。泛林集团收入146亿美元，其中三分之一以上来自中国——这一比例在所有大型设备制造商中居于首位（尽管该公司指出，其中有一部分是销售给在华经营的跨国公司）。

这种新的依赖带来了政治和商业上的问题，尤其是对应用材料、科磊和泛林集团这三家美国制造商。中国政府向本国芯片制造商投入了数千亿美元的资金。而由于这三家美国公司各自主导着芯片制造不同阶段的设备供应，这就不可避免地导向了一个结论：美国最先进的技术正在推动实现中国的经济目标。在华盛顿，两党看法高度一致，都认为这是不可接受的。

美国政府为这个令人不安的问题寻求解决方案已有时日。2020年12月，它将中国最重要的芯片制造商中芯国际列入出口黑名单。任何想向中芯国际销售产品的美国公司都必须申请许可证。但制造设备继续流向这家中国公司，部分原因是美国是在单打独斗。而中国政府慷慨的补贴转而流向了美国以外的竞争对手。应用材料指出，这可能成全了其他公司，因为实际上，不能进入中国市场“可能导致我们失去相对于国际竞争对手的技术领先地位”。

这个问题日益突出。4月12日，全球半导体设备行业组织国际半导体产业协会（SEMI）宣布，2021年，在该行业全球收入中，来自中国的份额增长了58%，达到296亿美元，从而巩固了它全球最大市场的地位。政治压力正在上升。3月，两名共和党议员致函美国商务部，要求收紧对中国的芯片技术出口管制，其中专门提到了芯片制造设备。

中国对芯片制造设备旺盛的需求也给中国大陆以外的芯片制造商带来了商业上的困难，令它们得不到设备，也就没法制造芯片。4月14日，台积电老板魏哲家表示，因为遇到意外的“设备交付问题”，公司可能无法生产足够的芯片。虽然他没有将问题归咎于大陆，但芯片业内人士说原因可能就在于此。据两名独立消息人士称，台积电已经提醒自己两个最大的客户苹果和高通，可能无法满足它们2023年和2024年的需求。

过去四个月里，美国的设备制造商已经开始通过总部位于华盛顿的律所兼游说公司Akin Gump做政府的工作，寻求解决问题的办法。为达成这一目标，这些设备制造商去年底成立了半导体设备制造商联盟（Coalition of Semiconductor Equipment Manufacturers），并聘请Akin Gump为代表。律师们一直在仔细研究应用材料、泛林集团和科磊的产品，试图在出口管

制措施中找到一些可行的办法，让那些不那么先进、不用于尖端制造的设备仍然可以卖到中国，而先进的设备则会被禁止。这可以让这些制造商保住部分在华收入。

对设备进行界定的工作还在继续。Akin Gump一直在代表该联盟游说内阁成员和国会两院领导人，并且目前仍在与拜登政府和国会议员磋商。“拜登政府正在推进这一计划。”该联盟在4月25日的一份声明中表示。

该计划的成效将取决于能否让美国的盟友——特别是分别拥有东京电子和阿斯麦的日本和荷兰——对各自的设备制造商实施同样的出口控制。随着俄罗斯进攻乌克兰，达成这种一致的可能性加大了。世界各地的官员已经在频繁磋商，以了解美国对俄罗斯的贸易禁令将对本国产生什么影响。这为把中国排除在先进芯片制造之外的复杂任务开辟了渠道，这可比限制石油或武器销售要棘手得多。

这个计划仍可能流产。中国不太可能温顺接受。华盛顿的鹰派可能会推动更严厉的限制措施。要界定哪些设备可以继续对中国出口难度可能过大。但如果成功，中国芯片制造商将需要几十年时间才能赶上西方，而美国则达成了压制中国半导体发展的目标，同时把对自己产业的损伤降到了最低。■



Braced for impact

The Fed's balance-sheet is about to shrink. Wall Street is not ready

Could the giant market for Treasury bonds seize up?

CONSIDER THE life of a Treasury bill or bond. Typically once or twice a week, a batch of fresh Treasuries are born. Their first home is usually, briefly, an investment bank's dealing desk. Those dealers might hold on to a few for themselves, but generally they distribute the bulk to more permanent owners, like the bond portfolios of a mutual fund, a foreign government or a company or the Federal Reserve. A certain slice will swap hands repeatedly—some \$700bn or so are traded each business day—but many will stay put for their lifetimes. Their deaths are predetermined: they come of age, or “mature”, as little as one month or as long as 30 years after their birth, at which point they are settled and cease to exist.

The Fed is the single largest holder of Treasuries—its balance-sheet is where many of those securities have found their permanent home. Thanks to bond-buying schemes put in place to ease monetary conditions during the pandemic, the Fed now holds some \$5.8trn-worth of Treasuries, a quarter of the \$23.2trn-worth the government has issued (see chart—it also holds \$2.7trn-worth of mortgage-backed securities). On May 4th, however, Jerome Powell, the chairman of the Fed, said it would start shrinking this giant portfolio, a process known as “quantitative tightening” (QT), in June. The reversal could spark a repeat of the temporary, yet troubling breakdowns that the world's most important financial market has suffered in recent years—on a bigger scale.

According to the policy statement released on May 4th, the Fed will reduce its balance-sheet not by actively making sales, but by letting bonds that have reached the end of their lives mature without buying a new bill or bond to replace them. By September, if all has gone to plan, the Fed's

portfolio will be shrinking by \$95bn a month, split between \$60bn of Treasuries and \$35bn of mortgage-backed bonds. At that pace the Fed's balance-sheet will shrivel by more than \$1trn over the next year. That is "quite the clip", says Darrell Duffie of Stanford University.

There are two reasons why investors and policymakers are watching QT closely. The first is its potentially vast impact on monetary policy. Estimates of the effect of bond-buying on the cost of money vary—but any downward pressure on interest rates exerted as the Fed bought up Treasuries is likely to be reversed as its holdings start to ebb. Two-year Treasury yields have already climbed from 0.8% in January 2022 to 2.7% as investors have come to expect quicker balance-sheet shrinking and faster rate increases. On May 4th Mr Powell announced a 50-basis-point rate rise, the first increase of that size since 2000, and signalled more would be "on the table at the next couple of meetings".

It is also possible that QT will cause the Treasury market to malfunction—the second reason for concern. Its smooth running matters well beyond America: Treasury rates are a crucial benchmark for pricing virtually all other financial assets globally. And recent history is not encouraging. A series of episodes—including the "flash rally" of 2014; stress in the repo market (a key money market where Treasuries can be swapped for cash) in September 2019; and the covid-19 shock of March 2020, in which the Treasury market in effect ceased to function for periods of time—have created serious doubts about how robust the Treasury market is.

Each of the episodes had slightly different causes. Regardless of the robustness of the Treasury market, there was little that would have stopped the extreme nature of the covid-19 shock from rocking it. The repo crisis was in part the result of some perverse incentives caused by post-crisis regulation that deterred banks from holding Treasuries. But both were

exacerbated by a deeper issue, says Randal Quarles, a former vice-chair for supervision at the Fed, which is that the Treasury market “has grown out of its waist size”.

A combination of financial-crisis stimulus, fiscal deficits under President Trump and pandemic-era splurge have caused the Treasury market to grow nearly five-fold since 2007. At the same time fresh regulation imposed on investment banks, which are the main conduits in Treasury markets, such as the introduction of the supplemental-leverage ratio, which measures the total size of bank assets relative to the amount of capital they hold, has restricted their ability to facilitate Treasury-market activity. The rule is not very friendly to low-risk activities, such as holding Treasuries. A report released last year by the Group of Thirty, an economics advisory body, warned that “the aggregate amount of capital allocated to market-making by bank-affiliated dealers has not kept pace” with its lightning growth.

To combat issues that have cropped up in the past the Fed has taken measures to increase liquidity, such as opening up a “standing facility” for selected intermediaries to swap Treasuries for cash. But few think that this is a panacea for dysfunction. Mr Duffie favours replacing the current market structure, which relies on broker-dealers, with a central-clearing system. This would make it easier for market participants to interact directly—for one mutual fund, say, to sell to another without relying on a bank to intermediate the transaction. But the fix would be no match for “the scale of the problem”, says Mr Quarles. A more urgent task, he argues, is to loosen the regulatory shackles hampering investment banks from supporting the market. That is unlikely to happen soon: there is little appetite in Washington for weakening bank regulation.

In the absence of an obvious fix, the unknowable fallout from the Fed’s pull-out is adding to the uncertainty created by rising rates, stagflation and geopolitical ructions. Liquidity in the Treasury market is already thinning:

the “yield error” captured by the Bloomberg Treasury liquidity index, which measures the difference between the yield a Treasury is traded at and a measure of fair value, is 12% higher than it was in January. It has more than doubled since August 2021. The growing possibility of renewed dysfunction could deter investors from dealing further, making it yet likelier that the market seizes up. The once-placid life of Treasury bills and bonds could get more chaotic for a while. ■



迎接冲击

美联储即将缩表，华尔街尚未准备好

庞大的美债市场会否失灵？

想一下短期或长期美国国债的一生。通常每周都会新诞生一到两批美国国债。它们一般会先暂居在某个投资银行的交易部门。这些交易商可能会自留一部分，但通常会把大部分债券分销给长期持有者，例如共同基金、外国政府、公司或美联储的债券组合。一部分债券将反复易手——每个交易日约成交7000亿美元——但许多一辈子都会待在一个地方。它们的死期早已注定：在诞生后的短则一个月、长则30年后到来。这称为“到期”，届时它们就会被结算，不复存在。

美联储是美债最大的单一持有者——它的资产负债表是大量美债的永久归宿。为了在疫情期间缓解货币状况，美联储实施了买债计划，它现在已持有约5.8万亿美元的美债，在已发行的23.2万亿美元美债中占四分之一（见图表——美联储同时还持有2.7万亿美元的抵押担保证券）。然而，美联储主席鲍威尔5月4日表示，将从6月开始缩减这一庞大的投资组合，这个过程被称为量化紧缩（QT）。这一逆转可能会引发世界上最重要的金融市场再现它近年经历过的那类短暂但令人不安的崩溃，而且规模会更大。

根据5月4日发表的政策声明，美联储不会通过主动出售债券来缩减其资产负债表，而是让债券自然到期而不再购买新的短期或长期国债来填补。如果一切顺利，到9月，美联储的投资组合将每月缩减950亿美元，包括600亿美元国债和350亿美元抵押担保债券。按照这个速度，美联储的资产负债表将在明年缩减超过1万亿美元。这是“相当快的速度”，斯坦福大学的达雷尔·达菲（Darrell Duffie）表示。

投资者和政策制定者密切关注QT的原因有二。首先，它有可能给货币政策带来巨大的影响。关于买债对资金成本的影响，各方估算不尽相同，但美联储买债对利率施加的任何下行压力应该会在它开始缩表时逆转。两年期美债收益率已经从1月的0.8%攀升至2.7%，显示投资者预期缩表步伐将会

加快、加息也会提速。5月4日，鲍威尔宣布加息50个基点，这是自2000年以来首次如此大规模加息，他还透露“在接下来的几次会议上将考虑”进一步加息。

QT也可能导致美债市场运转失灵——这是第二个令人担忧的原因。美债市场平稳运行的重要性远不止对美国境内：美债收益率是全球几乎所有其他金融资产定价的关键基准。而近些年的情况不怎么叫人放心。一系列事件已经让人们在美债市场是否稳健产生了严重怀疑——包括2014年的“闪涨”、2019年9月回购市场（一个可将美债兑换为现金的关键货币市场）的异常波动，以及2020年3月的新冠疫情冲击，当时美债市场实际停顿了一段时间。

每一次事件的起因都略有不同。且不论美债市场是否稳健，新冠疫情危机的那种极端特性带给它的冲击几乎无法避免。回购危机在一定程度上是由于在危机后采取的监管政策抑制了银行持有美债的积极性，导致了一些有悖常理的刺激作用。但美联储负责监管的前副主席兰德尔·夸尔斯（Randal Quarles）表示，一个更深层次的问题让这两次事件愈发严重，那就是美国国债市场“已经长得过于臃肿”。

金融危机时的刺激措施、特朗普任内的财政赤字，以及疫情中的大肆支出，使美国国债市场自2007年以来已经扩大了近四倍。与此同时，作为美债市场的主要流通渠道，投资银行又受制于一些新监管规定，例如补充杠杆率（银行总资产规模相对于持有资本规模的比率），限制了它们促进国债市场流通性的能力。这套规定并不利于持有美债等低风险活动。经济咨询机构三十人小组（Group of Thirty）去年发表的报告警告称，“为银行下属的交易商分配的做市资金总量未能跟上”市场的急速增长。

为了应对以往出现过的问题，美联储已采取措施增加流动性，例如设立“常备便利”，让指定的中介机构用美债换取现金。但没多少人认为这是治疗功能失灵的灵丹妙药。达菲倾向于用一套中央清算系统来取代目前依赖券商的市场结构。这将便于市场参与者彼此直接互动——例如一支共同基金可以将美国国债直接卖给另一支基金，而无需依靠银行担任交易中介。

但夸尔斯认为，这种解决方案并不适合“这么大的问题”。他提出，更紧迫的任务是放松那些阻碍投资银行支持市场的监管桎梏。这在短期内不太可能发生，因为华盛顿并无意放松对银行的监管。

在没有明确解决方案的情况下，美联储的离场后果如何还是未知之数，这让加息、滞胀和地缘政治动荡所造成的不确定性进一步上升。美债市场的流动性已经开始萎缩：彭博美债流动性指数测得的“收益率误差”比1月高出12%，该指数衡量了美债成交收益率与公允价值之间的差异。自2021年8月以来，该指数已经翻一番不止。市场再次发生运转失灵的可能性越来越大，投资者可能因此更加望而却步，进而导致失灵的可能性进一步上升。短期和长期美债曾经的岁月静好可能要混乱一阵子了。■



Lifting the silicon veil

The secrets of big tech

We dig inside the finances of Apple, Amazon and others

AMERICA'S TECH giants make ungodly amounts of money. In 2021 the combined revenue of Alphabet, Amazon, Apple, Meta and Microsoft reached \$1.4trn. These riches come from a wide and constantly expanding set of sources, from phones and pharmaceuticals to video-streaming and virtual assistants. Analysts expect the tech quintet's combined sales to surpass \$340bn in the first three months of 2022, around 7% more than in the same period last year.

In a quarterly ritual that kicked off on April 26th, when the big five started reporting their latest earnings, the staggering headline numbers again hit headlines. Alphabet unveiled revenues of \$68bn, up by 23% compared with a year ago, though slowing advertising growth saw net profit dip to \$16.4bn. On the same day Microsoft announced revenues of \$49.4bn, up by 18%, and net profits of \$16.7bn. A day later Meta revealed sales of \$27.9bn with net profits of \$7.5bn. Amazon and Apple reported after *The Economist* was published.

Big tech firms are understandably eager to trumpet these impressive figures, as well as their diverse offerings. They are considerably more coy about how much many of their products and services actually make. Annual reports and other public disclosures tend to lump large revenue streams together and describe them in the vaguest terms. Last year, for example, the five giants' sales were split out into 32 business segments in total. That compares with 56 segments for America's five highest-earning non-tech firms.

Apple breaks its sales into five slices; Meta into only three (see chart 1). The

category that Alphabet labels as “Google Other” made \$28bn in revenue last year. It includes Google’s app store, sales of its smartphones and other devices, and subscriptions from YouTube, a subsidiary. Last year YouTube’s advertising revenue, which Alphabet first revealed only in 2020, reached \$29bn. That means that in 2021 Google Other and YouTube’s ad business each generated more money than four-fifths of the companies in the S&P 500 index of the biggest American firms.

The opacity makes business sense. Keeping rivals in the dark helps ensure that they will not try to replicate a prized business unit and eat into its margins. Andy Jassy, Amazon’s boss, has lamented the prospect of breaking out his firm’s financials because they contain “useful competitive information”.

Annoyingly for the tech barons, the veil of secrecy is getting thinner. Regulators, lawmakers and investors see it as a problem, and are calling for more transparency about everything from how big tech’s payments platforms work to the amount of carbon the companies belch out. And new sources of information are emerging, from brokers’ reports, hedge-fund analyses and, most revealing, antitrust court cases brought by would-be competitors and competition regulators around the world. All these are bringing to light details about the inner workings of big tech.

To understand it all, The Economist has rifled through court documents, internal emails, analyst notes and leaked files about Alphabet, Amazon, Apple and Meta (Microsoft has managed to avoid antitrust scrutiny this time around, so secret information about its finances is scarcer). What emerges is a picture of big tech in which the titans appear more vulnerable than their ostensible omnipotence suggests. Their secretive profit pools are indeed deep. But the firms’ finance secrets betray weaknesses, too. Three stand out: a high concentration of profits, waning customer loyalty and the sheer sums at risk from assorted antitrust actions.

Start with the profit pools. The biggest of these tend to be transparent. The iPhone remains Apple's profit engine, Amazon rakes in most of its money from cloud computing, and Alphabet and Meta couldn't survive without online advertising. The firms are less forthcoming when it comes to disclosing details about their smaller but fast-growing units.

Perhaps the biggest untrumpeted sources of profits for Alphabet and Apple are their app stores. The firms take a commission on all in-app spending on these platforms, usually of up to 30% (though in a bid to appease regulators, they are increasingly offering lower rates for small developers and those whose apps rely on subscriptions). The revenue streams are middling. In 2019 they were around \$11bn for Google, according to one case brought against it in America by a group of state attorneys-general. Analysts estimate that for Apple's store they were \$25bn last year.

Because the costs of maintaining the app stores are low, however, the profit margins are vast. The operating margin for Apple's app store has been estimated at 78%, according to one case brought against the firm by Epic Games, a video-games maker. For Google the figure is 62%. That compares with an operating margin of 35% for Apple's overall business and of 31% for Alphabet's business as a whole (which continues to rely on advertising for revenues).

The app stores are booming. Revenues from related commissions for Google and Apple roughly doubled between 2017 and 2020, according to the Competition and Markets Authority (CMA), Britain's trustbusting agency. In 2020 Google's store had 800,000-900,000 developers offering 2.5m-3m apps. That made it slightly bigger than Apple's, which was home to 500,000-600,000 developers and 1.8m apps. There is no sign of the growth slowing down or margins shrinking, according to Apple's Epic case and the CMA probe. The gross margin on Google's app store has ticked up by a few percentage points in recent years.

In Apple's annual report its app-store revenues are in a category called "services", which made \$68bn in sales last year, or 19% of Apple's total. But the app store is not the most profitable subset of Apple's services. Though the exact figure is unknown, the gross margin on Apple's search-advertising segment is even larger than on its app emporium, the CMA reckons. That, according to the regulator, is down to a deal struck between Apple and Google. The terms mean that Google search is the default option on most Apple devices. In exchange, Google gives Apple somewhere between \$8bn and \$12bn a year (2-3% of Apple's total revenue). This arrangement costs Apple close to nothing, so it is nearly all profit.

Amazon and Meta are (a bit) less secretive about the sources of revenues and profits. Despite its rebranding and pivot to the virtual-reality "metaverse", Meta isn't shy about admitting that it continues to make 97% of revenues from online advertising. Amazon is happy to disclose revenues of its controversial Marketplace, where third-party vendors sell their wares, paying the equivalent of 19% of those sales for the privilege (up from 11% in 2017) and competing with Amazon's own retail business. Marketplace contributed \$103bn to Amazon's top line in 2021, a six-fold increase from 2015 and 22% of the firm's total.

But it took digging by analysts to estimate that Instagram accounted for \$42bn of Meta's revenues last year, nearly two-fifths of the total and up from a reported \$20bn, or a quarter of the total, in 2019. The photo-sharing app's role in the social-media empire's prospects has risen dramatically, in other words. And a lawsuit brought by the attorney-general of the District of Columbia that revealed Marketplace's profit margins to be 20%, four times higher than those of Amazon's own retail business (the case does not specify whether the margins in question were gross, net or operating).

| *Fair game*

All this makes for plenty of deep profit pools. Look closer, though, and they

are surprisingly narrow. In Apple's app store, for example, games account for 70% of all revenues, according to documents uncovered during the Epic court battle. Most of this comes from in-app purchases, such as wacky accessories for avatars or virtual currencies. In 2017, 6% of app-store game customers accounted for 88% of the store's game sales. Those heavy users spent, on average, more than \$750 each year.

The Epic trial also revealed that the top 1% of Apple gamers in terms of spending generated 64% of sales and splurged an average of \$2,694 annually. Internally these super-spenders are known as "whales", like their casino equivalents. An investigation by the CMA found a similar pattern at Google's app store. In 2020 around 90% of the store's British sales came from less than 5% of its apps. Once again spending on in-app features in games made up the vast majority of revenue.

Spending is concentrated in the online ad industry, too. Another CMA probe looked at data on British advertisers who spent a combined £7bn (\$8.9bn) in 2019 on Google Ads, an ad-buying tool aimed at small businesses. The top 5-10% of advertisers by spending made up more than 85% of revenue for Google Ads. The highest-spending sectors were retail, finance and travel. A similar exercise showed even greater concentration at Facebook. The top 5-10% of the social network's advertisers made up more than 90% of revenue (see chart 2). Retail, entertainment and consumer-goods firms splurged most.

Concentration is also present at the level of "impressions", as each incident of an advert appearing on a user's screen is known in the business. That was one finding of internal research by Google, which was unearthed as part of a case bought against the tech giant by another group of American state attorneys-general. The study found that in America 20% of all impressions produce 80% of web publishers' ad revenue. High-value impressions are ones aimed at users likely to make a purchase. Google

referred to this phenomenon internally as “cookie concentration”.

Besides a heavy reliance on a few big profit generators, another undisclosed weakness is customer churn. Tech giants’ customers are often assumed to be devoted to their products and services—or even hooked. The companies do not challenge this assumption in public, because it conveys the sense of captive markets, which are beloved of investors. In fact, their markets may not be quite so captive.

The Epic case revealed that roughly 20% of iPhone users who bought a new phone in 2019 and 2020 switched to another smartphone. Leaked documents from Meta show that fewer teenagers are signing up to Facebook and those that do are spending less time on it. Even Instagram, Meta’s youth-friendlier platform, is losing out to rivals. A leaked internal report from March last year found that teenagers were spending more than twice as much time on TikTok, a hipper short-video app.

Young people are not the only customers beginning to retreat from the platforms. So are young companies. Last year was a bonanza for startups. Global venture-capital funding reached \$621bn, more than double the previous year’s total. According to a report by Bridgewater Associates, the world’s largest hedge fund, of all the money invested in early-stage companies about a fifth is spent on cloud services, a market dominated by Alphabet, Amazon and Microsoft. Another two-fifths goes on marketing, which in the digital realm is dominated by Alphabet, Meta and, increasingly, Amazon. Bridgewater estimates that, all told, around 10% of the total revenue of Alphabet, Amazon and Meta is derived from the startup ecosystem. That is the equivalent of \$84bn each year.

That flow of money may be ebbing. Fears about rising inflation, Russia’s war in Ukraine and the chance of a recession has sent the share prices of tech firms tumbling. The NASDAQ, a tech-heavy index, has fallen by 20%

from its peak in November. Falls in public markets are filtering down to the startup world. On March 24th Instacart, a grocery-delivery firm, cut its own valuation by 38%. Lower valuations will in turn make it harder for firms to raise capital. Investors say they expect to see startups tightening their belts in the coming months. That means less spending on the cloud and ads.

What do all these vulnerabilities add up to? In the worst-case scenario, where the toughest-talking regulators in America, Britain and the EU get their way, the answer is an awful lot. Europe poses the biggest threat. The Digital Markets Act (DMA) is a sweeping new set of EU rules designed to rein in big tech that was finalised in March. It will only affect some business units and is targeted at tech's European operations. Bernstein, a broker, finds that Alphabet, Apple, Amazon and Meta make \$267bn of revenue, about a fifth of their combined total, in Europe. A back-of-the-envelope calculation by The Economist suggests the DMA puts perhaps 40% of the four firms' European sales at risk.

Globally, Alphabet is the most exposed, with nearly 90% of European revenues (equivalent to 27% of its global revenues) in danger. In America Google's search monopoly is being targeted in a case brought by a team of state attorneys-general. The Department of Justice is thinking about following suit. That puts American search revenue of \$70bn, a quarter of Alphabet's total, at risk of antitrust action. If Alphabet reduced its commission on in-app payments from 30% to 11%—the share agreed in a deal between Google and Spotify on March 23rd—American app-store revenues would plummet from \$11bn to \$4bn. Together these actions could imperil perhaps \$150bn of Alphabet's revenue, or about 60% of its global total.

| *Many appy returns*

Apple's worst-case exposure is smaller but still significant. If trustbusters put a stop to its sweetheart search deal with Google, that would imperil

\$8bn-12bn a year. Should Apple follow Alphabet's lead and slash app-store commissions, or be forced to do so by new laws, its app-related earnings would also drop, from about \$25bn to \$9bn. Apple's total exposure would be roughly \$35bn, or a tenth of global revenue. Amazon stands to lose up to \$77bn per year, or 16% of global revenue, if it is barred from mixing its own retail operations with those of third parties on Marketplace.

Some lawmakers and regulators have been murmuring about breaking up Amazon altogether, into a retailer and a cloud-computing provider, for example. The rump Amazon would either be deprived of its e-commerce sales (about 70% of current revenues) or its cloud profits (about three-quarters of its profits). The same voices are calling to split Meta. If America's Federal Trade Commission got its way and forced the social-media conglomerate to hive off Instagram and WhatsApp, the company could lose \$42bn in revenues from Instagram and another \$2bn from WhatsApp—or two-fifths of its total.

All told, if everything went against big tech, perhaps \$330bn in revenues would be at risk, or about a quarter of the total for Alphabet, Amazon, Apple and Meta. That is before including the two antitrust bills making their way through America's Congress. Among other things, these aim to stop platform owners, such as app stores and search engines, giving preferential treatment to their own products. The financial impact of such rules is hazy but could, as in Europe, be substantial.

This catastrophic case for big tech is unlikely to materialise. Many attempts to check the power of the platforms have gone nowhere. The current crop is likely to be watered down and could take years to take effect. But a few successful tech-bashing efforts could make a meaningful dent in the firms' prospects. And by lifting the veil on tech titans' secret finances, they are already alerting challengers to where exactly margins are ripest for eating into. ■



揭开硅谷面纱

科技巨头的秘密

我们对苹果和亚马逊等公司的财务状况一探究竟【深度】

美国的科技巨头赚钱能力惊人。2021年，Alphabet、亚马逊、苹果、Meta和微软的总收入达到1.4万亿美元。这些财富的来源广泛且不断扩大，从手机、药品，到流媒体视频和虚拟助手等。分析师预计，2022年前三个月，科技五巨头的总销售额将超过3400亿美元，较去年同期增长约7%。

4月26日，新一年季度财报启动，五巨头开始公布最新一季收益，惊人的数字再次登上新闻头条。Alphabet公布营收为680亿美元，同比增长23%，尽管广告增长放缓导致净利润下降至164亿美元。同一天，微软宣布首季营收494亿美元，增长18%，净利润达167亿美元。一天后，Meta公布营收为279亿美元，净利润75亿美元。亚马逊和苹果的数据在本刊本期付印后公布。

科技大公司自然很愿意宣传这些令人印象深刻的数字以及它们多种多样的产品和服务。但对于其中很多产品和服务到底创造了多少收入和利润，它们就远没这么开诚布公了。年报和其他公开披露的文件往往将大量收入来源合并在一起，对数字的说明也尽可能语焉不详。比如，去年科技五巨头的销售额总共划分为32个业务板块。相比之下，美国收入最高的五家非科技公司划分了56个板块。

苹果将销售收入划分为五块，Meta只分了三块（见图表1）。Alphabet标注为“谷歌其他”的那一类收入去年为280亿美元，其中包括谷歌的应用商店、智能手机和其他设备的销售，以及子公司YouTube的订阅收入。Alphabet在2020年才首次披露YouTube的广告收入，去年这一收入达到了290亿美元。这意味着，在2021年，“谷歌其他”和YouTube广告业务的收入双双超过了囊括美国最大公司的标普500指数中五分之四的公司。

蒙上这样一层面纱有商业上的道理。让竞争对手雾里看花有助于确保他们

不会试图复制一个重要的业务部门来分走利润。亚马逊的老板安迪·贾西（Andy Jassy）对未来可能要求详细披露公司财务数据感到遗憾，因为这些数据包含“有用的竞争信息”。

令科技大亨们恼火的是，这层保密的面纱越来越薄了。监管机构、立法者和投资者认为这样的保密是有问题的，正呼吁从各个方面提高透明度，包括科技巨头支付平台的运作方式和这些公司的碳排放量等。而新的信息源正在涌现，比如经纪商的报告、对冲基金的分析，以及由世界各地的潜在竞争对手和反垄断监管机构向法院提起的反垄断诉讼，这些诉讼尤其能揭示内情。所有这些都曝光科技巨头内部运作的细节。

为一探究竟，本刊翻阅了法庭文件、内部电子邮件、分析师报告和有关Alphabet、亚马逊、苹果和Meta的泄露文件（微软这次设法规避了反垄断审查，因此关于它财务状况的秘密信息要少得多）。我们由此得到了一幅科技巨头的全景图，从中可以看出表面上无所不能的巨头们实际上要更脆弱。它们的秘密利润池确实深厚，但其财务秘密也暴露了它们的弱点。其中有三点尤为突出：利润高度集中、客户忠诚度下降，还有各种反垄断行动带来的巨大风险。

先来说利润池。最大的利润池往往是透明的。iPhone仍然是苹果的利润引擎，亚马逊的大部分利润来自云计算，Alphabet和Meta离不开在线广告。而在披露规模较小但增长迅速的那些部门的情况时，它们就没那么开诚布公了。

Alphabet和苹果秘而不宣的最大利润来源可能是它们的应用商店。两家公司对这些应用商店内所有的应用内支出都要抽成，比例通常高达30%（尽管为了安抚监管机构，它们在不断降低对小型开发者和那些依赖订阅的应用的开发者的抽成）。这个收入来源的规模属于中等。根据多名州检察长在美国对谷歌提起的一项诉讼，2019年这些抽成给谷歌带来了大约110亿美元的收入。分析师估计，去年苹果商店的这项收入为250亿美元。

但是，应用商店的维护成本很低，因此利润空间非常大。根据电子游戏开

发商Epic Games提起的一起诉讼，苹果应用商店的营业利润率被估计为78%。谷歌的这个数字是62%。相比之下，苹果整体业务的营业利润率为35%，Alphabet为31%（它仍依赖广告获取收入）。

应用商店生意火爆。根据英国反垄断机构竞争与市场管理局 (CMA) 的数据，2017年到2020年间，谷歌和苹果应用商店的抽成收入大约翻了一番。2020年，谷歌的应用商店有八九十万名开发者提供了250万至300万个应用，规模略大于拥有五六十万名开发者和180万个应用的苹果商店。从Epic起诉苹果的案件和CMA的调查看，应用商店没有增长放缓或利润下降的迹象。近年，谷歌应用商店的毛利率还上升了几个百分点。

在苹果的年报中，其应用商店的收入被归入“服务”类别，该类别去年的销售额为680亿美元，占公司总销售额的19%。但应用商店并不是苹果服务中最赚钱的部分。虽然具体数字未知，但CMA估计苹果搜索广告业务的毛利甚至高于应用商店。按CMA的说法，这是由于苹果和谷歌达成了协议，在大多数苹果设备上把谷歌搜索设为默认选项。作为交换，谷歌每年向苹果支付80亿至120亿美元（占苹果总收入的2%至3%）。苹果在这项交易中几乎不需要付出任何成本，因此这笔收入基本都是利润。

亚马逊和Meta对收入和利润来源的保密程度要低（那么一点）。尽管改了名字并转向虚拟现实的“元宇宙”，Meta并没有对它97%的收入仍来自在线广告这一点遮遮掩掩。亚马逊很乐于披露其备受争议的Marketplace的收入，第三方供应商在那里销售商品，要为此向亚马逊支付相当于销售额19%的费用（2017年为11%），并与亚马逊的自营零售业务竞争。2021年，Marketplace为亚马逊贡献了1030亿美元的收入，是2015年的六倍，占公司总收入的22%。

Instagram的收入数据可是分析师花了一番力气才挖出来的。据估计，它去年为Meta贡献了420亿美元的收入，占Meta总收入的近五分之二，据称它在2019年的收入为200亿美元，占四分之一。换言之，在社交媒体帝国Meta的未来图景中，这个照片共享应用的地位已经大大提升。由华盛顿特区检察长提起的诉讼显示，Marketplace的利润率为20%，是亚马逊自营零

售业务的四倍（该案没有具体说明所提到的利润率是毛利率、净利率还是营业利润率）。

| 公平游戏

所有这些都造就了许多深厚的利润池。然而，仔细观察就会发现它们都出奇地狭窄。例如，根据在Epic官司中发现的文件，游戏占到了苹果应用商店总收入的70%。其中大部分来自应用内购买，例如玩家虚拟角色的各种古怪配件或虚拟货币。2017年，6%的游戏玩家贡献了应用商店游戏销售额的88%。这些重度用户平均每年花费超过750美元。

Epic一案还显示，支出前1%的苹果游戏玩家产生了64%的销售额，这些人平均每年花费高达2694美元。在内部，这些大玩家和赌场的大客户一样被称为“鲸鱼”。CMA的一项调查在谷歌的应用商店中发现了类似的模式。2020年，谷歌应用商店在英国约90%的销售收入来自不到5%的应用。同样，游戏应用内购买也占了收入的绝大部分。

在线广告支出同样集中。CMA的另一项调查研究了英国广告主的数据，2019年他们在针对小企业的广告位购买工具Google Ads上花了70亿英镑（89亿美元）。支出排名前5%至10%的广告主贡献了Google Ads超过85%的收入。支出最高的部门是零售、金融和旅游。一项类似的调查表明，Facebook的广告收入来源更加集中，它的前5%至10%的广告主支出贡献了收入的超过90%（见图表2）。零售、娱乐和消费品公司支出最多。

“曝光次数”（impressions）也过于集中，这是业内对一则广告在用户屏幕上出现的次数的称法。谷歌的内部研究发现了这一点，在另一群美国州检察长起诉这家科技巨头时公诸于世。这一研究发现，在美国，20%的曝光次数产生了网络出版商80%的广告收入。高价值曝光次数的对象是很可能做出购买的用户。谷歌内部将这种现象称为“cookie集中”。

除了高度依赖一些主要利润来源之外，另一个未公开的弱点是客户流失。人们通常以为科技巨头的客户会认准它们的产品和服务，甚至难以摆脱。这些公司不会在公开场合挑战这一假设，因为它传递出了垄断市场的感

觉，这是投资者很喜欢的。而事实上，它们对自己市场的垄断程度可能并没有那么高。

Epic一案显示，iPhone用户在2019年和2020年购买新手机时，约有20%转买了其他品牌的智能手机。从Meta泄露出的文件显示，注册Facebook的青少年越来越少，而那些已注册的青少年在Facebook上花的时间也越来越少。就连Meta迎合年轻人的平台Instagram也在败给竞争对手。去年3月泄露的一份内部报告发现，青少年在时髦短视频应用TikTok上花费的时间是Instagram的两倍多。

开始退出这些平台的客户不止年轻人，还有年轻企业。去年创业公司经历了一轮淘金热。全球风投资金达到6210亿美元，是上一年总额的两倍多。根据全球最大的对冲基金桥水基金（Bridgewater Associates）的一份报告，在所有投资于早期公司的资金中，约有五分之一用在了云服务上，而这个市场由Alphabet、亚马逊和微软主导。另外五分之二用于营销——数字领域的营销由Alphabet和Meta主导，亚马逊的影响力也越来越大。桥水估计，各方面加起来，Alphabet、亚马逊和Meta的总收入中约有10%来自创业生态系统，相当于每年840亿美元。

这部分收入可能正在减少。对通胀上升、俄乌战争以及可能出现经济衰退的担忧导致科技公司股价暴跌。以科技股为主的纳斯达克指数较去年11月的峰值下跌了20%。公开资本市场的跌势正在渗透到创业领域。3月24日，日杂配送公司Instacart主动将自己的估值下调了38%。较低的估值继而会让公司更难筹集到资金。投资者表示，他们预计未来几个月里创业公司可能会勒紧裤腰带。这意味着在云和广告上的支出将会减少。

所有这些弱点加起来会有什么后果？在最坏的情景下，也就是美国、英国和欧盟态度最严厉的监管机构得偿所愿的情况下，后果是严重的。欧洲构成的威胁最大。内容宽泛的欧盟新规则《数字市场法案》（DMA）意在约束科技巨头，已于3月最终敲定。它只会影响一些业务部门，主要针对科技业者的欧洲业务。根据经纪公司盛博的数据，Alphabet、苹果、亚马逊和Meta在欧洲的收入为2670亿美元，约占它们总收入的五分之一。本刊粗

略计算表明，DMA威胁到这四家公司欧洲销售额的大约40%。

在全球范围内，Alphabet面临的风险最大，它近90%的欧洲收入（相当于其全球收入的27%）都会受到影响。在美国，一批州检察长正在针对谷歌搜索的垄断地位提起诉讼。司法部正在考虑随后提起诉讼。这让谷歌在美国700亿美元的搜索收入（占Alphabet总收入的四分之一）面临反垄断诉讼的风险。如果Alphabet将其应用内支付的抽成比例从30%降低到11%（谷歌和Spotify于3月23日达成的协议中约定的比例），其美国应用商店的收入将从110亿美元暴跌至40亿美元。这些行动加在一起，可能将危及Alphabet约1500亿美元的收入，占其全球总收入的约60%。

| 应用回报多

苹果在最坏情况下的风险较小，但仍然影响重大。如果反垄断机构叫停它与谷歌私下达成的搜索交易，那每年将危及80亿至120亿美元的收入。如果苹果效仿Alphabet的做法削减应用商店抽成，或者被新法律强制这样做，那么它来自应用的收入也将下降，从约250亿美元降至90亿美元。苹果的总风险敞口约为350亿美元，占其全球收入的十分之一。如果禁止亚马逊将自营零售业务与Marketplace上的第三方销售混在一起，亚马逊每年将损失多达770亿美元，占其全球收入的16%。

一些国会议员和监管官员私下一直嘀咕着要分拆亚马逊，比如分为零售和云计算两部分。被肢解的亚马逊要么会丢了电子商务销售额（约占当前营收的70%），要么会丢了云计算的利润（约占其利润的四分之三）。这些人也在呼吁分拆Meta。如果美国联邦贸易委员会（FTC）得偿所愿，迫使Meta剥离Instagram和WhatsApp，该公司可能会损失420亿美元的Instagram收入和20亿美元的WhatsApp收入，共占其总收入的五分之二。

如果一切都对科技巨头不利，那么总共将有3300亿美元的收入面临风险，约占Alphabet、亚马逊、苹果和Meta总收入的四分之一。这还没有把两项正在美国国会审议的反垄断法案考虑在内。这两项法案的目标之一是禁止应用商店和搜索引擎等平台的所有者给予它们自己的产品优惠待遇。尚不清楚这些法规对财务有何影响，但就像欧洲的法规那样，影响有可能是巨

大的。

对科技巨头来说，这种灾难性情景不太可能成真。许多抑制平台势力的尝试都无果而终。眼下这一轮尝试很可能会打折扣，而且可能要好几年才会生效。但少数成功的打击仍可能显著影响这些公司的前景。而在揭开了科技巨头神秘的财务面纱后，它们已经在提醒挑战者哪些板块最适合抢夺利润了。 ■



Free exchange

How would an energy embargo affect Germany's economy?

Researchers draw some lessons from past episodes

RUSSIA'S DECISION to halt the supply of gas to Bulgaria and Poland has added fuel to an already heated debate in Germany, which is heavily reliant on the commodity. For weeks the country's economists and officials have argued over just how much a ban on Russian hydrocarbons would harm the economy. Now it seems imaginable that Russia itself could turn off the taps. What toll would an embargo take? A wide body of research, which examines a range of past disruptions, sheds light on the question.

The relationships between modern firms are not simple links connecting one producer with another, but a tangle of complex interactions. The breakdown of a seemingly insignificant link in the chain can disrupt firms that are either upstream or downstream of it, causing wider damage. In a paper published in 2019 David Baqaee of the University of California, Los Angeles, and Emmanuel Farhi of Harvard University used a model of complex supply networks to study the oil shocks of the 1970s. Linkages between firms and sectors meant that the overall economic effect was quite a bit larger than the direct impact on sectors that used oil. Recent research on the effect of social distancing on America by Jean-Noël Barrot, then of HEC Paris, and his co-authors finds that ripple effects through production networks accounted for more than half of the total economic impact.

Another much-studied instance of disruption is the earthquake that struck north-eastern Japan in 2011. As the worst-hit areas only accounted for less than a twentieth of GDP, local disruption should not have had a noticeable nationwide effect. But it did. In a review Vasco Carvalho of the University of Cambridge and colleagues disentangle the impact on the affected areas from the ripple effects along supply chains, and find that the latter

accounted for more than half the hit to Japanese growth.

Researchers have also uncovered the types of links and mechanisms that enable shocks to propagate widely. The shutdown of a company altogether is one way in which a jolt can create a much bigger economic hit, according to a paper by Daron Acemoglu of the Massachusetts Institute of Technology and Alireza Tahbaz-Salehi of Northwestern University (as well as another study by Mr Baqaee). That explains why Alan Mulally, then the chief executive of Ford, a carmaker, urged American lawmakers to bail out his competitors during the global financial crisis. Ford feared the collapse of the auto sector's suppliers, which would cause severe disruptions at its own plants, too.

Intimate commercial relationships, such as those within firms, tend to be especially affected, because they are harder to replace. Another study of Japan's 2011 earthquake by Christoph Boehm of the University of Texas, Austin, and others finds that the American subsidiaries of Japanese firms also suffered, as did their suppliers. Other research also concludes that the more customised the relationship between firms and their suppliers, the bigger the ripple effects. Mr Barrot and Julien Sauvagnat of Bocconi University examine 30 years of American natural disasters and find that disruption to just one supplier leads to a loss in sales for a downstream firm of two to three percentage points, which, considering that most suppliers provide a small portion of a firm's production inputs, is a sizeable fall.

Such findings provide fodder for opponents of an energy embargo in Germany. And some estimates of the impact of an embargo also suggest that the short-term disruptions could be large. Six leading German research institutes conclude that an embargo could lead to a GDP loss for the country of around 1% this year and 5% in 2023. The Bundesbank estimates a hit of 5% in 2022.

Yet there are two reasons why things need not be so bad. For a start, just as past experience shows that supply disruptions can have sizeable near-term effects, it also shows that the economy in aggregate has a great ability to adjust. In 2010 China banned the export of rare-earth metals to Japan, one of the world's biggest users of the minerals. Japanese firms were able to quickly substitute away from previously cheap rare earths and find alternative supplies, according to research by Eugene Gholz of the University of Notre Dame and Llewelyn Hughes of the Australian National University. In a study of the potential effects of a Russian energy embargo on Europe, Rüdiger Bachmann of the University of Notre Dame and his co-authors find that while the hit could be large, it would be partly offset by the economy's ability to adapt. The overall impact, they reckon, could be in the region of 0.5-3% of GDP.

| *Production, interrupted*

Moreover, it is within the gift of governments to mitigate the short-term pain of supply disruptions. EU officials, for instance, are mulling stricter sanctions on energy imports from Russia. The more notice firms receive about the measures, which could include a tax on Russian energy, the easier adjusting to them is likely to become. Past episodes suggest that if policymakers do want to change regulations or trade relationships, they should do so consistently and carefully. A liberalisation of Indian trade in the 1990s led to little wider disruption because it was gradual, helping firms adjust. A recent study by Alessandra Peter of New York University and Cian Ruane of the IMF points out that Indian firms were able to find substitutes for inputs.

Governments could also take into account the fact that businesses may not do enough to ensure that networks are solid in the near term. Matthew Elliott of the University of Cambridge and others find that firms might invest in the robustness of their supply chains if they have a business case

to do so. But they might not seek to ensure the resilience of the wider network, because they do not stand to reap the rewards from such investment. Encouraging firms and households to shift away from using fossil fuels, as a tariff would do, could enhance that resilience. Managed well, Germany's supply disruptions need not be quite so disruptive. ■



自由交流

能源禁运会如何影响德国经济？

研究人员从过往事件中得到一些启示

俄罗斯决定暂停向保加利亚和波兰供应天然气之后，在严重依赖天然气的德国，一场本已激烈的辩论更是火上浇油。几周以来，德国的经济学家和官员们一直在争论禁用俄罗斯油气究竟会对本国经济造成多大的损害。现在看来，俄罗斯可能会主动切断供应。禁运会造成多大的损失？许多研究分析了历史上各种供应中断事件，为回答这个问题提供了线索。

现代企业之间的关系并不是一家生产商与另一家生产商之间的简单连接，而是一团错综复杂的互动关系。链条中一个看似微不足道的环节一旦瘫痪，上下游的公司都可能受到波及，造成更大范围的破坏。在2019年发表的一篇论文中，加州大学洛杉矶分校的戴维·巴卡伊（David Baqaee）和哈佛大学的埃马纽埃尔·法希（Emmanuel Farhi）使用一个复杂的供应网络模型来研究1970年代的石油危机。由于企业与企业、行业与行业之间的种种联系，整体经济影响显著大于用油行业受到的直接冲击。近期，法国巴黎高等商学院（HEC Paris）的让-诺埃尔·巴罗（Jean-Noël Barrot）及共同作者研究了保持社交距离对美国的影响，发现整体经济影响当中有超过一半来自生产网络中的连锁反应。

2011年日本东北部的地震是另一个被深入研究的断供案例。由于受灾最严重的地区占全国GDP的比例还不到二十分之一，这种局部中断按理不会造成显著的全国性影响。然而事实却并非如此。在一篇综述中，剑桥大学的瓦斯科·卡瓦略（Vasco Carvalho）及其同事将受灾地区所受影响和供应链中的连锁反应拆分开来，发现日本经济增长所受的影响有一半以上归因于后者。

研究人员还发现了让供应冲击广泛蔓延的连接类型和机制。麻省理工学院的德隆·阿西莫格鲁（Daron Acemoglu）和西北大学的阿里雷扎·塔赫巴兹-萨利希（Alireza Tahbaz-Salehi）的一篇论文（以及巴卡伊的另一项研

究)认为,一家公司完全关停的震荡就可能引发更大规模的经济冲击。这也解释了为什么在全球金融危机期间,时任福特汽车首席执行官的艾伦·穆拉利(Alan Mulally)会敦促美国国会议员救助他那些竞争对手。福特担心汽车产业的供应商会难以为继,而这将导致他自己的工厂也发生严重断供。

紧密的商业联系(例如公司的内部关联)更加难以替代,因此尤其容易受到影响。得克萨斯大学奥斯汀分校的克里斯托弗·伯姆(Christoph Boehm)等人对2011年日本地震的另一项研究发现,遇到麻烦的还有日本企业的美国子公司以及供应商。其他研究也得出结论,企业和供应商之间关系的定制化程度越高,连锁反应就越剧烈。巴罗和博科尼大学

(Bocconi University)的朱利安·索瓦格纳(Julien Sauvagnat)分析了过去三十年美国发生的自然灾害,发现单单一家供应商生产中断就会导致一家下游企业的销售损失两到三个百分点。考虑到多数供应商在企业的生产投入中只占很小份额,这样的损失相当可观。

这些研究结果为德国反对能源禁运的一派提供了理据。而对禁运影响的一些估算也显示短期的破坏可能很大。德国六家主要研究机构认为,禁运可能导致该国GDP在今年损失1%左右,在2023年损失5%。德国央行则估计对2022年的冲击为5%。

但事情未必会那么糟糕,这有两方面原因。首先,虽然历史经验显示供应中断可能会带来相当大的短期影响,却也表明整体经济具有强大的调适能力。2010年,中国向世界最大稀土消费国之一的日本禁运稀土金属。根据美国圣母大学的尤金·戈尔兹(Eugene Gholz)和澳大利亚国立大学的卢埃林·休斯(Llewelyn Hughes)的研究,日本公司很快就为以往的廉价稀土找到了替代供应来源。在一项关于俄罗斯能源禁运对欧洲潜在影响的研究中,圣母大学的吕迪格·巴赫曼(Rüdiger Bachmann)和共同作者发现,尽管冲击可能会很大,但经济体的适应能力会弥补部分影响。他们认为,整体影响可能在GDP的0.5%到3%之间。

| 生产中断了

此外，政府也有能力减轻供应中断带来的短期痛苦。例如，欧盟官员正在考虑对俄罗斯能源进口实施更严厉的制裁。这些措施可能包括对俄罗斯能源征税，而企业越早提前获知消息，往往也越易于做出调整。过去的事件表明，如果政策制定者真想要改变监管或贸易关系，他们应该始终如一、小心谨慎地推进。1990年代印度的贸易自由化并没有导致大范围破坏，就是因为它的实施是渐进式的，有助于企业做出调整。纽约大学的亚历山德拉·彼得（Alessandra Peter）和国际货币基金组织的西恩·鲁恩（Cian Ruane）近期的一项研究指出，当时印度公司得以找到了生产投入品的替代供应。

政府也有可能想到，企业在确保生产网络短期可靠性上做得可能并不够。剑桥大学的马修·艾略特（Matthew Elliott）等人发现，企业或许愿意投资加固自己的供应链，只要这有商业利益上的理据。但它们未必会寻求确保更大范围供应网络的韧性，因为它们并不一定会从这类投资中获得回报。促使企业和家庭减少使用化石燃料可以增强这种韧性，而征收关税就有这样的效果。只要管理得当，德国的断供危机未必会有多大的破坏力。





The techno-king of Twitter

Elon Musk wants to re-engineer the “public square”

The world's best-known engineer gives himself another grand problem to solve

SWEEPING STATEMENTS about the future of humanity do not usually feature in discussions about leveraged buy-outs. But Elon Musk has never felt bound by convention. Asked about his plans to buy Twitter, a social network, and take it private—which were approved by the firm's board on April 25th—he went straight for the big idea. “My strong intuitive sense is that having a public platform that is maximally trusted and broadly inclusive is extremely important to the future of civilisation. I don't care about the economics at all.”

Compared with its rivals—Facebook, Instagram and TikTok—Twitter is a minnow. But the deal matters. One reason is that Twitter's size belies its importance. As a haunt of politicians, pundits and wonks, it does much to set the political weather—a digital “public square”, as Mr Musk put it.

Another is that Mr Musk made his name and his fortune by upending industries. This time, he will be grappling with a knotty problem of keen interest to governments around the world—how to regulate speech online. Most prescribe ever more rules. But Mr Musk wants to go the other way, removing restrictions instead of imposing new ones. The operators of other big social networks will be watching the experiment with interest.

At first blush, Mr Musk—best known for electric cars and reusable rockets—seems an unlikely social-media mogul. But a closer look suggests his acquisition of Twitter fits his approach to business. Mr Musk, a passionate engineer, likes to take poorly performing technologies and improve them. Tesla tore up the car industry's rule book by replacing petrol with electricity, ditching dealerships and treating cars as computers.

SpaceX proved that a hungry, move-fast-and-break-things startup run on a relative shoestring could outperform aerospace giants grown cautious and fat on the back of generous government contracts. Both firms were dismissed by bigger incumbents—until one day they weren't.

All that engineering and disruption is animated by Mr Musk's own, sometimes idiosyncratic conception of the social good. Tesla's purpose is to prod the world more quickly towards a carbon-free economy (a goal vindicated by the speed at which other carmakers are now pivoting to electric vehicles). SpaceX's ambition is so grandiose some commentators struggle to believe that Mr Musk is sincere: to establish a human presence on Mars, something that, were a catastrophe to befall Earth, might one day prove to have been an insurance policy for civilisation.

Assume that Mr Musk really is ready to spend billions of dollars of his own money to secure the "future of civilisation" (though he has a break clause should he get cold feet). The question is whether his vision of free speech on Twitter is sensible.

Twitter fits the pattern of Tesla and SpaceX, offering Mr Musk another complex engineering system to tinker with, and a grand reason for doing so. Social media deploy algorithms to highlight "engaging" content, using a thicket of rules that try to mitigate the worst side-effects, the better to sell users to advertisers. It is a business model full of inconsistencies and unexamined trade-offs that looks ripe for disruption. That Mr Musk wants to be its agent is perhaps no surprise, for he cut his entrepreneurial teeth in the 1990s, when techno-libertarianism and anti-censorship were the internet's animating ideas.

The fact that Mr Musk is a billionaire should not disqualify him from owning an important media firm. He has already set out some ideas for Twitter, many of them cautious and sensible. The resulting fuss shows how

illiberal much online opinion has become. He wants fewer outright bans and more temporary suspensions. Users should prove they are not bots. When in doubt, err on the side of leaving tweets up, not taking them down.

More significant, he thinks the cogs and ratchets of Twitter's recommendation algorithm, which decides which tweets a user sees, should be public. Researchers could examine it; other programmers could tweak it. A version less prone to pushing "engaging" content—which, in practice, often means tweets that are enraging, controversial or plain daft—could lower the temperature of the entire platform, making the job of moderation easier and possibly leading to debate that is more thoughtful. Or perhaps Twitter could become an open platform, where different users may choose one of many different third-party algorithms—or none at all—according to their taste. Content moderation is the messy product of political and social pressures. It will be fascinating to see how easily it succumbs to engineering.

Mr Musk will not have an entirely free hand. Australia, Britain, the EU and India, have all been working on tech-regulation. Thierry Breton, a senior EU official, noted that "It's not [Mr Musk's] rules that will apply here." Mr Musk's other investors are nervous. The more time he devotes to Twitter, the less he will have for his other ventures. Shares in Tesla fell by 12% after news of the Twitter deal.

Mr Musk's personality poses a big risk. He is clever, driven and ferociously hard-working. He can also be puerile and vindictive, traits on display in 2018 when he accused a British cave-rescue expert, with no evidence, of being a "pedo guy". Such outbursts are one thing coming from a Twitter user with a big following. But when he is the owner, they will raise questions about whether he will be able to resist the temptation to exploit his new position to pursue his own obsessions and vendettas.

| *The bird and the oak tree*

This newspaper shares Mr Musk's free-speech convictions. Nobody has a monopoly on wisdom. Experts are sometimes wrong and blowhards sometimes right. Even in the internet age, the best response to a bad argument is a better one. Moderation on many platforms has become heavy-handed and arbitrarily enforced. If Mr Musk's talent for shaking up industries can help cut the Gordian knot of online speech, everyone will benefit.

But we are also keen on another liberal principle, that institutions should be bigger than the person running them. Mr Musk can set new rules, but he should be seen to play no role in enforcing them. If he really wants to convince users that he will be an impartial guardian of his "digital public square", he could implement his reforms—and then freeze his own account. ■



【首文】推特的“电音之王”

马斯克想要改建“公共广场”

全球最著名的工程师又给自己揽了个大活

在对杠杆收购的讨论中一般不会出现关于人类未来的宏大论述。但马斯克向来不受成规条框约束。在被问到收购社交网络推特并将其私有化的计划时（推特董事会已于4月25日批准该计划），他径直抛出了一个大胆的想法：“我有个强烈的直觉，建立一个被充分信任且广泛包容的公共平台对人类文明的未来极为重要。我根本不关心什么经济收益。”

相比其对手Facebook、Instagram和TikTok，推特只是条小鱼。但这次收购不是小事。一个原因是推特不大的规模掩盖了它的重要性。作为政客及专家学者的聚集地，这个平台在决定社会的政治气候上有非同小可的影响。正如马斯克所说，这是一个数字“公共广场”。

另一个原因是，马斯克是靠颠覆行业扬名发家的。而这一次，他是要去对付一个世界各国政府都非常关心的棘手问题：如何监管网络言论。大多数政府都在制定更多法规。但马斯克想要反其道而行——取消而非增加限制。其他大型社交网络的运营商将密切关注这场实验。

乍看之下，凭电动汽车和可重复使用的火箭闻名于世的马斯克似乎不太可能成为一位社交媒体大亨。但仔细观察会发现，收购推特符合他一贯的商业思路。这位充满激情的工程师喜欢把表现糟糕的技术拿来加以改进。特斯拉以电代油，抛弃经销商，视汽车为计算机，撕碎了汽车产业的规则手册。SpaceX则证明了一家积极进取、快速破局的创业公司即使资金相对有限，也完全可以胜过那些靠丰厚的政府合同赚得盆满钵满却日渐固步自封的航空航天巨头。特斯拉和SpaceX曾经都不被规模更大的老牌公司放在眼里，直到有一天无法被忽视。

这些工程设计和颠覆都是由马斯克本人对社会公益有时特立独行的构想促成的。特斯拉的使命是推动世界更快实现无碳经济，如今其他汽车制造商

快速转向电动汽车印证了这一目标。SpaceX的抱负之宏大让一些评论家难以相信马斯克是认真的：要在火星上建立人类定居地，万一哪天地球发生灾难，这将是给人类文明的一份保险。

就算马斯克真准备自掏几十亿美元来确保“人类文明的未来”（他与推特签有中断条款，仍可以临阵退出），问题在于他关于推特言论自由的愿景是否明智。

推特符合特斯拉和SpaceX的模式，是又一个可供马斯克摆弄修补的复杂工程系统，而且有宏大的理由这么做。社交媒体运用算法来突出“吸睛”内容，采用复杂的规则试图减轻那些最坏的副作用，以便更好地把用户卖给广告主。这样的商业模式充满矛盾和未经深思的取舍，看起来已经是时候被颠覆。马斯克想要引领这场颠覆也许并不令人意外，毕竟他是在上世纪90年代初出茅庐，而当时互联网的思想风潮正是科技自由意志主义和反审查。

不能因为马斯克是亿万富翁而取消他拥有一家重要的媒体公司的资格。他已经为推特提出了一些设想，其中许多是审慎而明智的。由此引发的争论表明网络舆论已变得多么不自由。他希望减少永久封号，而更多采取暂时禁言。用户要证明自己不是机器人。存在疑问时，宁可保留推文，而非删帖。

更重要的是，他认为推特应公开推荐算法的内在机制，这一算法决定了用户可以看到哪些推文。研究人员可以分析它，其他程序员可以调整它。“吸睛”内容实际往往是一些激起愤恨、具有争议或非常愚蠢的推文，而采用不那么倾向推送这些内容的算法版本可以给整个平台降温，减轻审核难度，也许还能导向更有深度的辩论。又或者，推特可以成为一个开放平台，不同用户可以根据自己的喜好，从众多不同的第三方算法中选择一种或者根本不使用算法。内容审核是政治和社会压力下的烦人产物。看看工程设计能否轻易改变它，会很有意思。

马斯克不可能完全不受约束。澳大利亚、英国、欧盟和印度都在制定科技

监管法规。欧盟高级官员蒂埃里·布雷顿（Thierry Breton）指出：“这里施行的不会是（马斯克的）规则。”马斯克其他项目的投资者很紧张。他花在推特上的时间越多，给其他项目的就越少。他收购推特的消息传出后，特斯拉的股价下跌了12%。

马斯克的个性是一大风险。他聪明进取、极度勤奋，但有时候又显得幼稚而记仇，比如2018年他在没有证据的情况下指斥一位英国洞穴救援专家是“恋童癖”。如此狂躁言语出自一个拥有大量粉丝的推特用户之口是一回事。但当他成为推特的老板，这类行径会让人质疑他能否抵制诱惑，不利用新权位追逐自己的执念，公报私仇。

| 小鸟与橡树

本刊认同马斯克言论自由的信念。没有人能垄断智慧。专家有时是错的，吹牛大王有时是对的。即使在互联网时代，对糟糕论调的最好回应是提出更好的观点。许多平台的内容审核已变得严苛而武断。假如马斯克撼动行业的才华天赋能够快刀斩乱麻，帮助解开网络言论的死结，所有人都将受益。

但我们也珍视另一条自由主义原则，即制度应大于其管理者。马斯克可以制定新规则，但决不应插手这些规则的执行。要让用户确信他将是“数字公共广场”不偏不倚的公正卫士，他可以推行改革，然后冻结自己的账号。■



Fear of floundering

China should worry less about its currency

...and more about its economy

IT IS EASY to forget that the world's second-biggest economy is still an emerging market. China's global clout, its technological prowess in certain fields, and even its low bond yields all distinguish it from the typical member of its asset class. But in at least one respect China resembles a classic emerging market: it retains a palpable fear of floating its currency. Instead China keeps a close eye on the yuan's value against the dollar and a basket of its trading partners' currencies, limiting any sharp movements.

For most of the past year, it worried that the yuan would float too high. China's largely successful efforts to stamp out the early variants of covid-19 kept its factories open and its borders closed. That allowed its exports to boom, putting upward pressure on the yuan, even as outbound tourism and other services imports suffered, removing a source of downward pressure. The yuan rose sharply against the basket of trading partners' currencies and gently against the dollar, which was itself strong.

Now China's fight against the pandemic is instead contributing to the currency's sudden weakness. Lockdowns stringent enough to hamper manufacturing have been imposed on Shanghai and other cities accounting for over 9% of GDP, according to Gavekal Dragonomics, a consultancy. China's economic figures for April will "certainly be disastrous", it says. The war in Ukraine has contributed to outflows from China's bond and equity markets, as foreigners reassess the risks of investing in countries at geopolitical loggerheads with the West. And as America has lost its fear of the virus, its economy has overheated, forcing the Federal Reserve to raise interest rates. In April the nominal yield on ten-year Treasuries briefly exceeded that on Chinese bonds for the first time since 2010. (Real yields

remain much higher in China, where consumer-price inflation is only 1.5%, compared with 8.5% in America's larger, more "mature" economy.)

A weaker yuan is both a reflection of these challenges and one way to cope with them. It will in particular help to shore up China's exports. But the central bank is not prepared to let the currency be dominated by market forces. It bears the scars of past falls in the yuan, which took on a momentum of their own. On April 25th it said it would cut the amount of reserves banks are required to hold from 9% of their foreign-exchange deposits to 8%. That will release some dollars to the market, alleviating pressure on the yuan. The move also signals the central bank's displeasure at the speed of its currency's descent.

China's currency worries may deter the central bank from cutting interest rates to revive growth. That will leave its economy more dependent than ever on fiscal stimulus. At a meeting of the powerful Central Committee for Financial and Economic Affairs on April 26th, Xi Jinping, China's president, called for more investment in infrastructure, from rural roads and urban drains to smart electricity grids and artificial-intelligence platforms. Citigroup, a bank, forecasts that infrastructure spending could grow by 8% this year. But according to Natixis, another bank, China will not meet its (increasingly forlorn) growth target of around 5.5% unless infrastructure investment grows by almost 18%. Even a conventional emerging market with vast infrastructure needs would struggle to boost spending by that much. China's fear of floating has inhibited its monetary response to its economic woes. And that has raised fears of its floundering. ■



困境之忧

中国应该少担心点汇率

.....多担心点经济

人们很容易忘记世界第二大经济体仍然是个新兴市场。中国的全球影响力、在某些领域的技术实力，甚至较低的债券收益率，都让它有别于同一资产类别中的一般成员。但至少在一个方面，中国仍然像是一个典型的新兴市场：它对浮动汇率始终有着明显的担忧。中国密切关注人民币对美元以及一篮子贸易伙伴国货币的汇率，限制任何剧烈波动。

过去一年的大部分时间里，中国担心人民币会升得过高。中国在遏制新冠病毒早期变异株方面的努力大体上是成功的，它的工厂得以复工，边境仍然关闭。这让它的出口蓬勃发展，给人民币带来了上行压力，而同时出境旅游和其他服务进口受困，消除了下行压力来源。人民币对一篮子贸易伙伴国货币的汇率大幅上升，对强势的美元的汇率也小幅度上升。

现在，中国的抗疫反而促使人民币突然走软。咨询公司龙洲经讯

（Gavekal Dragonomics）的数据显示，上海和其他一些城市已经实施了足以阻碍制造业的严格封锁，而这些城市的GDP之和占全国比例超过9%。它认为中国4月的经济数据“肯定是灾难性的”。乌克兰的战争已经加剧了中国债券市场和股市的资金外流，因为外国人在重新评估投资于那些与西方存在地缘政治分歧的国家的风险。随着美国不再担心新冠病毒，它的经济已经过热，迫使美联储加息。4月，十年期美国国债的名义收益率自2010年以来首次超过了中国国债。（中国国债的实际收益率仍然高得多，而中国的消费者价格通胀仅为1.5%，经济规模更大更“成熟”的美国为8.5%。）

人民币贬值既是这些挑战的体现，也是应对这些挑战的一种方式。它尤其能帮助支撑中国的出口。但中国人民银行并不准备让市场力量来主导人民币汇率。它还记着之前人民币贬值造成的创伤，那种下行自带冲力。4月25日，人行宣布将金融机构外汇存款准备金率从9%降至8%。这会向市场

释放一些美元，减轻人民币的压力。此举也表明人行不乐见人民币以眼下这种速度贬值。

中国对货币的担忧可能会阻止人行通过降息来恢复经济增长。这将让中国经济比以往任何时候都更依赖于财政刺激。在4月26日召开的中央财经委员会重磅会议上，国家主席习近平呼吁加大对基础设施的投资，从农村道路、城市排水，到智能电网和人工智能平台，等等。花旗银行预测今年基础设施支出有可能增长8%。但法国外贸银行（Natixis）称，除非基础设施投资增长近18%，否则中国将无法实现其（越来越无望的）5.5%左右的增长目标。即便是基础设施需求巨大的传统新兴市场也难以将支出提高这么多。中国对浮动汇率的忧虑让它难以运用货币政策工具应对经济问题。而这引发了人们对它泥足深陷的担忧。 ■



Take this, sucker

Big tech wants to bootstrap carbon removal into a big business

A consortium of technology firms is ploughing nearly \$1bn into a clever market mechanism

A GROUP OF rich do-gooders tried a bold experiment 15 years ago. The Gates Foundation, a charity, and five countries put \$1.5bn into a pilot project aimed at encouraging research and development in a previously neglected area. The “advanced market commitment” (AMC) they created promised rewards to drugmakers that came up with an effective vaccine against pneumococcus, a disease which killed many children in poor countries. Defying sceptics, three vaccines have since been developed. More than 150m children have been immunised, saving 700,000 lives.

Now several initiatives aim to apply the same approach to a different scourge. Last month four big tech companies—Alphabet, Meta, Shopify and Stripe—and the sustainability practice of McKinsey, a management consultancy, pledged \$925m over nine years to bootstrap technology to remove carbon dioxide from the atmosphere in an effort to arrest global warming. A similar AMC-esque project is expected to be unveiled in May at the annual plutocrat retreat in Davos hosted by the World Economic Forum (WEF). That project’s instigators in the First Movers Coalition, which was forged last November and unites the WEF, America’s State Department and dozens of big global firms, have already made purchasing commitments aimed at helping to decarbonise the aviation, shipping, trucking and steel industries.

Experts reckon the world must remove about 6bn tonnes of CO₂ a year from the atmosphere by 2050 to avert the worst impacts of climate change. Less than 10,000 tonnes have so far been permanently extracted in this way. Closing the gap thus requires heavy-duty bootstraps.

To be eligible for the tech companies' scheme, known as the Frontier Fund, carbon-removal technologies have to pass several tests (besides obvious ones like being safe and legal). One is permanence: the technologies must be able to store the stuff sucked from the air for at least 1,000 years. Another is scalability: they must not have land-use requirements that are in conflict with food security. A third is cost: they must have a path towards a price tag of less than \$100 per tonne of carbon dioxide removed (down from hundreds of dollars or more per tonne for existing techniques). These are "absolutely foundational to getting anything close to net-zero", says Mark Patel of McKinsey.

The goal is not to invest in carbon-tech startups, explains Nan Ransohoff of Stripe, which controls the Frontier Fund and will chip in more than a quarter of the kitty. Rather, the idea is to be early customers for the nascent carbon-removal techniques, which can help meet the buyers' own decarbonisation targets. For early-stage carbon-suckers, the fund will offer low-volume pre-purchase agreements. For bigger firms scaling up proven methods, it will offer larger contracts that pay providers for tonnes of carbon once these are delivered to the agreed specifications. Suppliers can then use these commitments to secure financing and expand capacity.

"A billion dollars is a big number but not even close to big enough," concedes Peter Freed, who leads the project at Meta. But, he hopes, it may "start a snowball rolling down the hill". And, if all goes well, it will keep some snow from melting, too. ■



我预购，你除碳

科技巨头想要撬动除碳大产业

由几家科技公司组成的联盟注资近10亿美元，打造一个聪明的市场机制

十五年前，一群富裕的行善者做出了一次大胆尝试。慈善机构盖茨基金会和五个国家联手，投资15亿美元建立了一个试点项目，鼓励在一个此前被忽视的领域展开研发。肺炎球菌在贫穷国家造成了许多儿童死亡，他们建立的“预先市场承诺机制”（advanced market commitment，以下简称AMC）承诺回报能研制出有效的肺炎球菌疫苗的制药商。在那之后有三种疫苗研制了出来，回击了质疑的声音。超过1.5亿儿童接种了疫苗，70万人的生命得以拯救。

现在，有几项计划想要以同样的方式对抗另一场灾难。4月，四家大科技公司——alphabet、Meta、Shopify和Stripe——以及管理咨询公司麦肯锡的可持续发展部承诺在九年内投入9.25亿美元，来启动从大气中去除二氧化碳的技术发展，以遏制全球变暖。世界经济论坛将于本月在达沃斯举办年度富豪聚会，预计届时将推出一个类似的AMC式的项目。该新项目的发起方是去年11月成立的先驱者联盟（First Movers Coalition），它联合了世界经济论坛、美国国务院和数十家大型全球公司，已经做出了采购承诺来帮助航空、海运、公路货运和钢铁产业脱碳。

专家们认为，要避免气候变化的最糟糕影响，全球必须在2050年前每年从大气中清除约60亿吨二氧化碳。目前以这种方式从大气中永久清除的碳还不到1万吨。因此，要填补这个缺口需要结结实实的启动力量。

由科技公司组织的项目名为“前沿基金”（Frontier Fund），除碳技术要获得参与资格须通过几项测试（除了安全、合法等必不可少的测试之外）。一是永久性：这些技术必须能把从空气中吸取的碳储存至少1000年。二是可扩展性：不能有与食品安全相冲突的土地使用要求。三是成本：每吨二氧化碳的清除成本必须最终能控制在100美元以下（现有碳清除技术的成本为每吨数百美元甚至更高）。麦肯锡的马克·帕特尔（Mark Patel）说，

这些“绝对是接近净零排放的基础条件”。

项目的目标并非投资碳技术创业公司，Stripe的南·兰索霍夫（Nan Ransohoff）解释说。该公司是前沿基金的控股股东，将出资超过四分之一。相反，其目的是要成为新兴碳清除技术的早期客户，而这些技术能帮助买家实现自己的脱碳目标。对于刚起步的碳吸收工厂，该基金将提供小额的预采购协议。对于扩大应用已验证方法的较大的公司，基金将提供更大的合同，约定一旦供应商按协议细则交付，就会按除碳吨数获得付费。供应商继而可以拿着这些合同获得融资、扩大产能。

“10亿美元是个大数目，但还远远不够。”在Meta负责该项目的彼得·弗里德（Peter Freed）承认。但是，他希望这也许能“让雪球从山上滚下来”。而且，如果一切顺利的话，它也会防止一些雪融化。■



The Russian treatment

Could the West punish China the way it has punished Russia?

New economic weapons are double-edged swords

“WOULD THE US really dare to freeze or confiscate China’s reserve assets?” asked Wang Yongli, a former director of Bank of China, in an article in March. Good question. After Russia invaded Ukraine, America and its allies imposed crippling sanctions on Russia’s central bank, removing from its reach about half of its foreign-exchange reserves. They also cut off some of Russia’s biggest banks from the Western financial system and banned many high-tech exports to the country. If China were to do something geopolitically rash, such as invading Taiwan, could the West do to China what it has done to Russia?

America and its allies certainly have the means. “The locus of financial power still sits firmly in the West,” says Eswar Prasad of Cornell University. China probably keeps about two-thirds of its \$3.2trn of foreign-exchange reserves in Western government bonds and the like. Because of the size of its holdings, it has few viable alternative stores of wealth. If America and Europe instruct their financial institutions not to deal with Chinese banks, they would lose access to the dollar, euro and pound.

But would the West really dare? “Freezing” China’s reserves might not be too destabilising. Even if China wanted to dump its holdings to spite the West, the sanctions would prevent it from doing so. China would be unable to buy more of these securities. But the bond markets would not miss it much. China has not been a big buyer of late. And by invading Taiwan it would create panic, triggering a stampede into highly rated bonds from private investors.

China could find other ways to punch back, though. In particular, it could

seize the sizeable assets that Westerners hold in China. At the end of last year, foreigners owned \$3.6trn in direct investments, including immovable factories, and \$2.2trn in shares, bonds and other “portfolio” investments, notes Gerard DiPippo of the Centre for Strategic and International Studies, a think-tank in Washington. The combined total is over six times the size of the equivalent foreign holdings in Russia.

What if the West also imposed sanctions on other Chinese financial institutions, beyond the central bank? That could expose Western institutions to financial “blowback”. Four of the world’s 30 “systemically important” banks are Chinese, according to the Financial Stability Board, a group of regulators. Crippling these banks could also damage Western institutions that have lent to them or hold accounts with them. Could Western countries be confident that cutting off Chinese banks would leave their own financial stability undisturbed? “No,” says Clay Lowery of the Institute of International Finance, a bankers’ group. “I’m not confident of that.”

Such measures would also wreak havoc with trade. Less than a fifth of China’s trade last year was settled in its own currency. Much of the rest was conducted in dollars. “If you can’t get insurance and trade credit, a lot of economic activity dries up,” says Martin Chorzempa of the Peterson Institute for International Economics, a research organisation. Since China is the leading trade partner of over 120 countries, the disruption might turn the rest of the world against America and its allies.

Western countries would suffer, too, which could erode their unity and resolve. China accounts for about 18% of America’s imports and over 22% of the EU’s, including many parts and components used in domestic manufacturing (see chart). For this reason, obstructing trade with China can damage a country’s own production, including its exports. If America and its allies were to cut Chinese imports by over 90%, their own exports

would fall by almost 10%, according to simulations by Gabriel Felbermayr of the Vienna University of Economics and Business and his co-authors.

China's biggest source of leverage is its own vast market. America might, for example, wish to deprive it of certain high-tech inputs, such as semiconductors. But a complete ban would cost American semiconductor firms 37% of their revenues, according to Boston Consulting Group, and jeopardise over 120,000 jobs.

China, for its part, might curb exports of the "rare earths" used in many electronic goods. It could disrupt the supply chain for electric-vehicle batteries and other manufacturing niches. And it could squeeze adversaries out of markets they might not want to forfeit. European sanctions, for example, initially spared Russia's \$2.4bn market for luxury goods: the so-called "Gucci exemption". The same market in China is worth over \$50bn a year, according to Statista, a data provider.

The West can hit Russia with a harder economic punch any time it tries to hit back. The same is not necessarily true with China, says Eddie Fishman of the Centre for a New American Security, a think-tank. That in turn makes it more likely that China would indeed hit back. America and its allies could, then, suffer considerable pain if they imposed on China the same sanctions they have inflicted on Russia. For that reason, they would probably not dare go that far. But they must hope that China does not dare to find out. ■



俄式待遇

西方会像惩罚俄罗斯那样惩罚中国吗？

新的经济武器是把双刃剑

“美国真敢冻结或没收中国的储备资产吗？”中国银行前执行董事王永利在3月撰文发问。好问题。俄罗斯入侵乌克兰之后，美国及其盟友对俄罗斯央行实施了严厉的制裁，使其无法动约一半的外汇储备。它们还切断了部分俄罗斯大型银行与西方金融体系的联系，并禁止对俄出口许多高科技产品。如果中国在地缘政治层面贸然行事，比如大陆“武统”台湾，西方会像对付俄罗斯那样对付中国吗？

美国及其盟友当然有对付中国的手段。“世界金融的权力中心仍稳稳扎根西方。”康奈尔大学的埃斯瓦尔·普拉萨德（Eswar Prasad）表示。在中国3.2万亿美元的外汇储备中，大概三分之二是西方政府债券之类的资产。由于储备规模庞大，中国几乎没有其他可行的储备方式。如果美国和欧洲命令其金融机构停止与中国的银行往来，后者将无法获得美元、欧元和英镑。

但西方国家真的敢吗？“冻结”中国的外汇储备或许并不会造成太大震荡。即使中国想要抛售其持有的资产来反击，也会因制裁而无法实施。中国将无法购买更多此类证券，但债券市场对此也不会多在意，因为中国近来买的并不多。而“武统”台湾会引发恐慌，触发私人投资者蜂拥抢购高评级债券。

不过，中国可以找到其他的反击方式。特别是中国可能会没收西方人在华持有的大量资产。截止去年年底，包括厂房在内，外国人在华持有3.6万亿美元的直接投资，还有2.2万亿美元的股票、债券和其他“组合”投资，华盛顿智库战略与国际研究中心（Centre for Strategic and International Studies）的杰拉德·迪皮波（Gerard DiPippo）指出。所有这些加起来是外国在俄罗斯持有同类资产的六倍多。

如果西方对中国除央行以外的其他金融机构也实施制裁又会如何？这可能会使西方机构面临金融“反噬”。据监管机构组织金融稳定委员会

（Financial Stability Board）的数据，全球30家“系统重要性”银行中有四家来自中国。重创这些银行也可能损害向它们提供贷款或在它们那里开设有账户的西方机构。西方国家有没有信心，在切断与中方银行的联系时不干扰自身金融稳定？“没有，”银行家组织国际金融协会（Institute of International Finance）的克莱·楼瑞（Clay Lowery）说，“我没这个信心。”

这种措施还会严重破坏贸易。去年，中国在贸易中用人民币结算的比例还不到五分之一，其余大部分使用美元结算。“如果得不到保险和贸易信贷，许多经济活动将无以为继。”彼得森国际经济研究所（Peterson Institute for International Economics）的马永哲（Martin Chorzempa）表示。由于中国是120多个国家的最大贸易伙伴，这种破坏可能会让世界其他国家转而反对美国及其盟友。

西方国家也会蒙受损失，这可能削弱它们的团结和决心。中国占美国进口总额约18%，占欧盟进口总额超过22%，当中包括许多用于本国制造业的零部件（见图表）。因此，阻碍与中国贸易会对包括出口在内的本国生产造成损害。维也纳经济大学（Vienna University of Economics）的加布里埃尔·费尔伯梅尔（Gabriel Felbermayr）及共同作者的模拟显示，如果美国及其盟友将从中国的进口削减90%以上，那么它们自己的出口将下降近10%。

中国最大的筹码是它那广阔的市场。例如，美国可能想要对中国断供某些高科技投入品，比如半导体。但根据波士顿咨询公司的数据，全面禁运半导体将使美国半导体公司损失37%的收入，并危及超过12万个工作岗位。

而在中国这一边，它可能会限制出口用于许多电子产品的“稀土”。它可能扰乱电动汽车电池和其他细分制造领域的供应链。还可能把敌人挤出他们可能并不想失去的市场。例如，欧洲的制裁最初并不涉及俄罗斯24亿美元的奢侈品市场——也就是所谓的“古驰（Gucci）豁免”。据数据供应商

Statista统计，中国这一市场的价值每年超过500亿美元。

每次俄罗斯试图回击，西方都可以施以更猛烈的经济打击。但对于中国却未必能如此，智库新美国安全中心（Centre for a New American Security）的艾迪·菲什曼（Eddie Fishman）表示。这就使得中国更有可能做出反击。那么，如果美国及其盟友对中国施加对俄罗斯的那套制裁，它们可能要遭受相当大的痛苦。出于这个原因，它们大概不敢走到这一步。但它们只能指望中国不敢试试看。 ■



Geopolitics and war

When central banks face sanctions

Central banks must grapple with geopolitics, too

THINK OF A central bank in dire straits, and Turkey's might come to mind. Recep Tayyip Erdogan, the president, has sacked three of its bosses in three years in pursuit of his wacky economic ideas, one result of which is inflation of 60%. Or Lebanon, where the central bank orchestrated a scheme to funnel bank deposits to the government. Riad Salameh, its long-standing governor, faces charges of corruption and money-laundering, and is reportedly in hiding.

The latest to hit trouble is the Central Bank of Russia (CBR). When Russia faced economic sanctions from the West for invading Crimea in 2014, Elvira Nabiullina, its governor, let the rouble float and introduced an inflation target. But now Russia's invasion of Ukraine has led to sanctions aimed directly at the central bank, blocking access to foreign-exchange reserves. Unable to use about half of the \$630bn in its war-chest, the CBR had to raise interest rates briefly to 20% and impose capital controls.

Speculative attacks against other currencies have long been part of the arsenal of economic statecraft, says Harold James of Princeton University, in the belief that a financial crisis would force the enemy to spend less on its army. During the second world war America froze Japan's foreign assets, and banned traders from buying gold from Japan. More recently, it took aim at Iran's central-bank assets in 2011-12, as it tried to stop the Iranian nuclear-weapons programme. The American government estimates that Iran can still access only a tenth of its \$100bn in reserves. After the Taliban seized control of Afghanistan, America also froze \$7bn in assets held by the Afghan central bank at the Federal Reserve. In an executive order, President Biden said that the administration would eventually seek to spend some of

the money on aid for Afghanistan.

The CBR has tried to reduce its reliance on American financial plumbing: the share of its reserves in dollars fell from nearly half in 2017 to less than a quarter in 2022. But it increased its holdings of euros, suggesting it may not have expected sanctions from Europe. It is now subject to sanctions from America, Britain, Canada, the EU, Japan and Switzerland. Most of the reserves that it can still access are in either gold or the yuan.

Geopolitics has always influenced foreign-exchange reserves, along with trade, convenience and safety. The obliteration of Russia's financial war-chest will have been noted especially in countries like China, which has around \$3.5trn in reserves, and India and Saudi Arabia, with \$590bn and \$472bn, respectively. The result may be a continued reduction in the dollar's dominance. According to the IMF, it accounted for 60% of global reserve holdings in 2021, down from 70% in 2000.

Where to go instead? Gold could regain lustre. But although it is a good store of value, it must be sold to be useful, and financial sanctions will deter potential buyers. It is also a hassle to move. The CBR's holdings amount to more than 180,000 bars, much of it kept in Russia, estimates Steve Cecchetti of Brandeis University. Safely transporting any of these to China or India, say, would be a costly affair.

What seems most likely is that "each reserve manager lives in their sphere of influence", predicts Mr Cecchetti, buying currencies only of friendly countries. China's yuan stands to gain: it makes up only about 3% of global currency reserves now. But the gains may be modest. Only a quarter of the diversification away from the dollar over the past 20 years has been to the yuan, according to Barry Eichengreen of the University of California, Berkeley. China's closed financial system makes buying many yuan-denominated bonds and securities far from easy. And if America can freeze

a central bank's foreign assets, it is not hard to imagine China one day doing the same. ■



地缘政治与战争

当央行面临制裁

央行也须费力应对地缘政治【专题《央行》系列之二】

要说哪国央行处境水深火热，你可能会想到土耳其。总统埃尔多安在三年里炒掉了三位行长，以追求自己古怪的经济理念，其结果之一是通胀飙到了60%。又或者黎巴嫩，其央行策划了一个方案来把银行存款转移给政府。长年担任行长的里亚德·萨拉马（Riad Salameh）面临腐败和洗钱指控，据报道目前在潜逃中。

最新一家遇到麻烦的是俄罗斯央行（CBR）。当俄罗斯在2014年因入侵克里米亚面临西方经济制裁时，其行长埃尔维拉·纳比乌利娜（Elvira Nabiullina）允许卢布自由浮动并制定了通胀目标。但现在，俄罗斯入侵乌克兰招致了直接针对俄央行的制裁，禁止它使用外汇储备。由于其6300亿美元的战争资金中约有一半无法动用，CBR不得不一度将利率提高到20%并实施了资本管制。

长期以来，对他国货币的投机性攻击一直都是经济战略武器之一，因为人们相信财政危机会迫使敌人减少在军队上的支出，普林斯顿大学的哈罗德·詹姆斯（Harold James）表示。第二次世界大战期间，美国冻结了日本的国外资产，并禁止贸易商从日本购买黄金。更近些时候，它试图阻遏伊朗的核武器计划，而在2011和2012年间瞄准了伊朗的央行资产。美国政府估计伊朗目前只能动用其1000亿美元储备中的十分之一。塔利班控制阿富汗后，美国也冻结了阿富汗央行在美联储持有的70亿美元资产。在一项行政命令中，总统拜登表示，其政府最终将寻求把这些钱的一部分用于援助阿富汗。

CBR已经在试图减少对美国金融管道的依赖：其以美元持有的外汇储备份额从2017年的近一半下降到2022年的不到四分之一。但它增加了欧元的持有量，这表明它可能没有预期会受到欧洲的制裁。现在它遭到美国、英国、加拿大、欧盟、日本和瑞士的制裁。它仍可以动用的储备大多为黄金

或人民币。

地缘政治一直都影响着外汇储备，以及贸易、便利及安全。俄罗斯战争资金被封会尤其被中国、印度和沙特阿拉伯等国看在眼里，它们分别持有约3.5万亿美元、5900亿美元和4720亿美元的外汇储备。这可能导致美元的霸主地位继续削弱。据国际货币基金组织称，2021年美元占全球外汇储备份额为60%，而2000年为70%。

那不存美元存什么呢？黄金可能会重焕光芒。但是，尽管黄金是一种很好的保值工具，它得要卖出去才能发挥用处，而金融制裁会吓退潜在的买家。搬运黄金也很麻烦。布兰代斯大学的史蒂夫·切凯蒂（Steve Cecchetti）估计，CBR持有超过18万根金条，其中大部分都存放在俄罗斯。要把其中任何一根安全运到譬如中国或印度都代价不菲。

切凯蒂预测，看起来最可能发生的是，“每家储备管理机构都会待在自己的势力范围内”——只买友好国家的货币。中国的人民币势必会获益：它目前仅占全球外汇储备的3%左右。但增长可能不大。加州大学伯克利分校的巴里·艾肯格林（Barry Eichengreen）表示，过去二十年里，减持美元的那部分只有四分之一转买了人民币。中国封闭的金融体系使得要购买大量以人民币计价的债券和证券绝非易事。而且，如果美国可以冻结一家央行的国外资产，不难想象中国某天也会做同样的事。■



Metabolism, digested

An ode to Tokyo's Nakagin Capsule Tower

And to a more optimistic time

THE NAKAGIN CAPSULE TOWER stands out from its unremarkable neighbours in Tokyo's Shimbashi district. Made up of 144 identical cuboids, stacked upon and jutting out from each other, the modular tower is both unabashedly futurist and subtly respectful of tradition. Each cuboid has a round window that evokes both space travel and the ancient architecture of Kyoto. They contain built-in living spaces composed of bath units, beds, desks and household electronics. Kurokawa Kisho, the building's architect, envisioned his cramped "capsules" as dwellings for what he called Homo movens, or highly mobile modern humans, such as the businessmen who lived in distant suburbs and worked late in Tokyo offices.

When the tower first went up in 1972, it became a prime example of Metabolism, an influential architectural movement in post-war Japan. Metabolism's chief exponents had studied under Tange Kenzo, an architect whose works included the park and memorial built in Hiroshima to commemorate the nuclear attack of 1945. The Metabolists designed buildings to be adaptable and replaceable, and resilient to threats such as wars and earthquakes. But not, alas, to neglect. On April 12th work started on demolishing the tower, following a long but ultimately futile battle to preserve it.

Given that, it is ironic that Metabolists sought to shift thinking about architecture from the mechanical to the biological, conceiving of cities as organisms that grew and changed rather than as static constructions to be planned and maintained. "We regard human society as a vital process, a continuous development from atom to nebula," they declared in their first manifesto, written ahead of the World Design Conference in Tokyo in 1960.

Their ideas were informed both by Western modernism and Eastern philosophy, drawing particular inspiration from Japan's Ise shrine, which has been entirely reconstructed almost every 20 years since the 7th century. Metabolism also embodied the energy of Japan's rapid-growth era. The Metabolists did more than just design buildings: in their hands, architecture became a field for reimagining Japanese identity after the ravages of the war.

In their texts, the architects pondered the relationship between technology and humanity. They considered the demands of designing cities for a growing urban population and a humming economy. They envisioned structures that floated over the seas and reached for the skies. Kurokawa called his capsules "cyborg architecture", where "man, machine and space build a new organic body".

The ideas were characteristic of an era of change and possibility. "There was great momentum in society," says Maeda Tatsuyuki of Nakagin Capsule Tower Preservation and Restoration Project. "It was a period when society was bolder and could afford to do such things."

By the end, the structure was decaying and riddled with asbestos. Many of the capsules were no longer habitable. The tower's destruction serves as a reminder of the relative caution of contemporary Japan. "These days, nobody would dare to build anything like that," Mr Maeda sighs. Yet it is also reflective of the same culture of impermanence that once inspired the Metabolists. In Japan, buildings are traditionally made of wood and paper, not intended to last centuries. There is not much of a preservationist movement. "Japan seems to demolish things before there's even debate," says Mr Maeda.

Still, fans and residents of the Nakagin tower had hoped to raise funds to replace the capsules, in line with Kurokawa's initial concept. They had been

in negotiations about buying the building. But the pandemic halted any momentum they had. Mr Maeda's group now hopes to rescue some 40 individual capsules, remove the asbestos, recreate the interiors and give them new lives at museums around the world. Mr Maeda compares the process to a "withered dandelion" spreading its seeds. "The capsules will take on a life of their own, scattered across different locations." It is in keeping with the spirit of Metabolism. ■



新陈代谢，充分消化

一曲颂歌，献给东京的中银胶囊塔

还有那个更加乐观的时代

在东京新桥一片平平无奇的街区內，中银胶囊塔显得卓尔不群。这座模块式塔楼由144个相同的方形建筑模块参差堆叠而成，既彰显未来主义，也有对传统的含蓄致意。每个方块都有一扇让人联想到太空旅行和京都古建筑的圆形窗户。内里的生活空间包含浴室、床、书桌和各种家电。其建筑师黑川纪章的设想是，这些狭小的“胶囊”可为他所谓的“移动人”（Homo movens）提供居所，例如家住远郊而需要在东京的办公室工作至夜深的商务人士。

中银胶囊塔于1972年建成，成为战后日本兴起的一个有影响力的建筑流派——新陈代谢派——的典范。其主要倡导者曾师从丹下健三，这位建筑师的作品包括广岛纪念1945年原子弹爆炸的公园和纪念馆。他们的设计理念是让建筑具有适应性和可替换性，能抵御战争和地震等威胁。可惜却没包括抵御疏于维护的威胁。4月12日，中银胶囊塔的拆除工作启动，此前争取保留该大楼的长时间努力终告徒劳。

新陈代谢派当年一心倡导要把建筑当做生命体而非机械物来对待，认为城市应该是不断生长变化的有机体，而不是需要规划和维护的静态构造。对比中银胶囊塔如今的命运，一切显得颇为讽刺。他们在1960年东京世界设计大会（World Design Conference）召开前发表的首个宣言中提出：“我们把人类社会看作是一个充满生机的历程，是一个从原子到星云不断发展的过程。”

他们的理念同时受西方现代主义和东方哲学的影响，尤其从日本的伊势神宫汲取灵感，该神宫自七世纪以来几乎每隔20年就会全面重建一次。新陈代谢派也体现了日本快速增长的年代里的那种精气神。这一派的建筑师不仅是在设计建筑：在他们手中，建筑成了一个在受战争蹂躏后重构日本身份

这些建筑师撰文讨论技术和人类的关系。他们思考城镇人口不断增长和经济蓬勃发展对城市设计的需求。他们设想着漂浮在海上和延伸向天空的建筑结构。黑川纪章称自己设计的胶囊方块为“赛博格建筑”，在里面“人、机器和空间构成了一个新的有机体”。

这些想法正体现了那个充满变化和可能性的时代。“那时社会上冲劲十足，”参与“中银胶囊塔保护修复行动”的前田达之说，“那个时期，社会更大胆，也承受得住这样的尝试。”

到最后，中银胶囊塔日益破败，石棉污染严重。里面许多胶囊房间已不再适合居住。大楼被拆除印证当代日本社会变得相对谨慎。“现在没人敢建造这样的东西了。”前田达之叹道。但这也正体现了那种催生了新陈代谢派的无常文化。在日本，传统建筑由木材和纸张建造，并不求千百年屹立不倒。建筑保护运动也不多见。“日本在拆东西前似乎都不会先讨论一下。”前田达之说。

尽管如此，中银胶囊塔的粉丝和住户曾希望筹集资金来更新胶囊，就像黑川纪章最初设想的那样。他们先前已经在就买下这栋楼展开谈判。但新冠疫情令一切进展戛然而止。前田达之的行动小组现在希望能保住这里面的约40个胶囊，清除其中的石棉，重新设计内部构造，让它们在世界各地的博物馆里重获新生。前田达之把这比作是让“枯萎的蒲公英”传播种子。“这些胶囊将散落在不同地方，觅得新生。”这正契合了新陈代谢派的精神。





Looking ahead

The curse of being too competent

The temptation to heap jobs on central banks must be resisted

A CENTRAL BANK'S reputation is determined as much by its relationship with the government as by its handling of financial crises and economic downturns. Over the past 300 years, as governments have sought to enhance or sometimes restrict central banks' powers, the mood has varied from collaborative and harmonious to antagonistic and fractious. By the end of the 20th century the tone had shifted to a grudging respect. Politicians came to learn that they interfered with central banks at their peril. The technocrats were told to aim for some combination of low inflation, high employment, a stable financial system and a reliable currency, and were mostly left alone to get on with the job.

As this special report has laid out, the line between intrusive politics and independent central banking is now blurring again. This is not just because central banks have bought vast quantities of public debt in an attempt to shore up economies. They have also come closer to disbursing implicit subsidies on their own account. During the pandemic they did this to keep firms alive. Now they are mulling schemes to deal with such issues as climate change. They are being pressed to solve various social problems. And they are toying with digital currencies that, in their most radical form, could expand their role in allocating credit further still.

This expansion in powers echoes across the emerging world. Central banking in the rich world has inched towards the approach in China, with its greater emphasis on its balance-sheet and credit guidance, and its multiplicity of aims. The PBoC tends to be called in to solve economic problems, says one observer, because it is regarded as more competent than other ministries. The existence of targeted-lending schemes has made it

easier for the PBoC to nudge credit towards green borrowers. And among large economies, China was the first to put a digital currency to the test.

In the rich world, central banks' greater use of their balance-sheets was to a large degree unavoidable as they sought to deliver their mandated goals. Unable to pull the lever of interest rates, they were forced to experiment with new tools. The exceptional circumstances of the pandemic justified a wide, indiscriminate safety-net. It would equally be foolish for central banks to ignore emerging risks and technologies. Geopolitics will become a more important influence on their decisions. Governments may instruct central banks to issue digital currencies. And understanding how climate change could affect the economy and the financial system is a vital task.

| *Laser focus*

What should be fiercely resisted, however, is the endless addition of new policy goals. For one thing, as the examples of climate change and inequality show, not all problems can be fixed by monetary policy. Even in China economists have concluded that it is too blunt a tool to wield against long-standing structural woes. And in democracies the question of how best to subsidise the worthy or tax the unworthy is surely better left to elected and accountable politicians, rather than to technocrats.

Central banks were given independence so as to focus on a narrow remit. That explains why they retain legitimacy in the eyes of the public. But to heap more tasks on central banks risks pulling them into the political sphere, opening them up to ever increasing demands. That would undermine their position as neutral technocrats and could, ultimately, raise doubts about their independence. A survey by Ms Binder and Ms Skinner, the two academics, found that college-educated Americans were much more amenable to the Fed playing an active role in tackling climate change and inequality than those without a college education.

More important today, considering that inflation in the rich world is running at around 8%, is that a proliferation of aims would interfere with the tasks that only central banks can do. For as long as inflation was low, central banks may have seen little harm in venturing into new areas. Its resurgence should serve as a timely reminder of why they were given independence in the first place, and why their mission matters. Pressing social problems may continue to make them seem like convenient dogsbodies to governments. The real question for them now is whether they can control inflation, and at what price. Focus on their core job will remain crucial. ■



展望

能者多劳的诅咒

必须抵御把各种活儿都往央行身上堆的诱惑【专题《央行》系列之三】

一家央行的声誉取决于它和政府的关系，同样也取决于它如何应对金融危机和经济衰退。过去三百年里，各国政府试图增强或（有时）限制央行的权力，关系氛围在合作、和谐与对立、暴躁之间摆动。到了上世纪末，气氛变成了一种带点不情不愿的尊重。政客们开始意识到干预央行于自己无益。技术官僚们被告知要追求低通胀率、高就业率、稳定的金融体系和可靠的货币。他们大体上被放手去独立做这项工作。

正如本专题所阐述的，干预式政治和独立央行业务之间的界限正又一次模糊了起来。这不仅仅是因为各地央行大举购入公共债务以求提振经济。它们也已接近用自己的账户分发隐性补贴。疫情期间它们就这么做来帮助企业活下去。眼下它们正在琢磨对抗气候变化等问题的方案。它们被敦促要去解决各种各样的社会问题。此外，它们也在捣鼓数字货币，这种货币最激进的形式有可能进一步扩大它们在信贷分配中扮演的角色。

这种权力的扩张在整个新兴世界中都能看到。富裕国家的央行运作已逐渐向中国的模式靠拢，后者更强调资产负债表和信贷指导，并设立多重工作目标。一位观察人士表示，中国人民银行往往被召唤来解决经济问题，因为它被认为比其他部委更有能耐。人行已有定向贷款计划，使它更容易把信贷稍稍导向绿色借款人。此外，在大型经济体中，中国是第一个测试数字货币的。

在富裕国家，央行更多地借助自己的资产负债表，在很大程度上是为了实现法定目标不得已而为之。由于无法拉动利率这根杠杆，它们被迫试验新工具。疫情的特殊情形给了它们理由来提供广泛而不加选择的安全网。央行若忽视新冒头的风险和技术同样会是愚蠢的。地缘政治将成为影响其决策的更重要因素。政府可能会指示央行发行数字货币。而了解气候变化会如何影响经济和金融体系是一项重要任务。

| 高度专注

然而，无休止地增加新的政策目标应该被强烈抵制。首先，正如气候变化和不平等的例子所表明的那样，并非所有问题都可以用货币政策来解决。即使在中国，经济学家也已得出结论，它是一种过于粗钝的工具，不适用于解决长期存在的结构性问题。而在民主国家，像如何能最好地补贴有价值的项目而对无价值的项目征税这样的问题，无疑是更应该留给民选上台的、负有责任的政客，而不是技术官僚。

央行被赋予了独立性，以便专注于狭窄的职责范畴。这是它们在公众眼中保有合法性的原因。但是，让央行承担更多任务有可能把它们拖入政治领域，让它们面对不断增加的需求。这会削弱它们作为中立的技术官僚的地位，并最终引发对其独立性的质疑。两位学者宾德和斯基纳的一项问卷发现，有大学教育背景美国人远比其他美国人更乐于接受美联储在对抗气候变化和不平等问题上发挥积极作用。

今天，有鉴于富裕国家的通胀率已经飙升到了8%左右，更重要的一点是，大量增加目标会干扰唯有央行才能完成的任务。当通胀处于低位时，央行可能看不出探入新领域有什么坏处。通胀的复苏应是一种及时的提醒：为何它们当初会被赋予独立性，以及为何它们的使命很重要。紧迫的社会问题可能会继续令它们成为政府眼里很好使的勤杂工。而现在对它们而言，真正的问题是能不能抑制住通胀，以及要为之付出什么代价。专注于核心工作仍将至关重要。 ■



Social issues

When central banks become one-stop policy shops

Central banks are under pressure to cure social ills

ALL AROUND the world politicians are exercised by the yawning gap between haves and have-nots. For every \$1 the average white American household earned in 2019, the average black one made only 51 cents. For every \$1 in wealth held by a white household, a black one owned just 15 cents. Joe Biden came into the presidency promising to tackle such disparities, vowing that “The dream of justice for all will be deferred no longer.” In New Zealand Jacinda Ardern, the prime minister, promised to “make homeownership possible again”. House prices went up by more than 25% in 2021, making property among the least affordable in the OECD club of mostly rich countries. “Anyone else want to leave New Zealand purely because of the housing crisis?” asked one buyer on an online forum. “This housing market sucks.” In China, the conspicuous gap between rich and poor and slowing social mobility spurred President Xi Jinping to launch a campaign of “common prosperity” last year, which took aim at everything from tech firms to celebrities.

Central banks seem almost as preoccupied with income distribution. According to a database maintained by the Bank for International Settlements (BIS), words relating to inequality cropped up in a tenth of speeches made by central bankers last year, compared with about 2% before the financial crisis. (By contrast, mentions of inflation drifted down.) In America about 15% of research papers published by the Federal Reserve studied inequality in 2021, up from about 5% in 2005, according to research by Carola Conces Binder of Haverford College and Christina Parajon Skinner of the Wharton School at the University of Pennsylvania.

This greater attention in part reflects a response to arguments that central

banks have worsened inequality by keeping interest rates low and boosting asset prices. But they also face calls to do more to remedy inequality and other social ills directly. And they sometimes embrace a social role themselves. Recent experiences in America, China and New Zealand provide illustrations.

In America progressive Democrats have called on the Fed to tackle racial gaps in employment, income and wealth. In April 2021 the House financial services committee passed a bill proposing to amend its mandate, which requires it to aim for price stability and maximum employment, to add demands that it tries to eliminate racial gaps. “Systemic racism and inequality is not something that happens on its own—it is a result of specific policy choices and the Fed must take deliberate action to fix it,” said Elizabeth Warren, a senator for Massachusetts.

Research shows that black workers benefit most from long expansions. Black unemployment is not only always higher than white unemployment (the current gap is about three percentage points) but also tends to rise faster in bad times. As the labour market tightens, excluded workers are drawn in, and the gap starts to close. This suggests that if monetary policy stays loose for longer, it will enhance equality. As the Fed reviewed its strategy in 2020, when inflation looked low, it leapt on the idea, redefining its goal of maximum employment as “broad-based and inclusive”. “This change reflects our appreciation for the benefits of a strong labour market, particularly for many low- and moderate-income communities,” said Jerome Powell, the Fed’s chairman.

| *Betting the house*

In 2021 the Reserve Bank of New Zealand became the first central bank to have house prices included in its remit, 31 years after it became the first to be given an inflation target. As in other rich countries, the central bank is seen as a big contributor to the housing boom. At the finance minister’s

instruction, and subject to its primary inflation and employment goals, the RBNZ must now “have regard to house prices” and the government’s objective of making property affordable for first-time buyers.

By contrast, the PBoC has long had a multiplicity of goals. Chief among them is currency and economic stability. But the government has also asked it to improve the economic structure, implement reforms and enhance household welfare. Since 2014 the PBoC has conducted “structural monetary policy”, which targets credit to different sectors through subsidised lending facilities, to boost specific parts of the economy without worsening debt problems for overextended state-owned firms. As of June 2021, according to its Monetary Policy Report, it had lent nearly 1.5trn yuan (\$234bn) to support rural development, small and midsize firms and poverty alleviation. The push to lend to small firms also supports the wider common-prosperity campaign, by lifting employment and therefore household income, says Helge Berger, the IMF’s mission chief for China.

Many economists doubt these attempts can succeed. One problem is that interest rates are a blunt tool. To have a big effect, the macro hammer must be used with great force, but that risks breaking other things. A study by Stephanie Aaronson of the Brookings Institution, a think-tank, and others suggests closing the gap between black and white men’s unemployment rate requires headline unemployment in America to fall to 1%. Another paper by economists at the New York Fed suggests that a percentage-point interest-rate cut reduces the gap in unemployment rates for black and white workers by less than 0.2 percentage points. Closing the wedge would require interest rates to fall by more than ten percentage points. Even if that were possible, it would overheat the economy and stoke serious inflation.

The economics linking monetary policy and inequality is “confused”, says Larry Summers of Harvard University (and a former Treasury secretary). He has spoken before of the danger that “woke” central bankers neglect rising

inflation. Easy money buoys asset prices by design—and white people own an outsize share of those assets. The New York Fed researchers find that interest-rate cuts lead to large gains in white households' wealth, far outweighing the impact of lower unemployment and higher incomes for black families. High inflation tends to affect the poorest in society most. Another study by Fed economists suggests that black households suffer more from inflation spikes, because they consume more goods with volatile prices. Both suggest that interest-rate increases, rather than decreases, would be a way to narrow disparities. The question of whether to raise or lower interest rates is a conundrum which the RBNZ would also face. It could raise interest rates to bring down house prices, but that would slow the economy, thereby denting the incomes of prospective homebuyers.

There is also debate over whether low rates cause inequality. Adrian Orr, the RBNZ's governor, has pointed to the global savings glut, which holds down interest rates globally, and the low availability of housing, as reasons for the boom: the central bank plays only "a bit part". Agustín Carstens, head of the BIS, says there is little central banks can do to counter the side-effects of low interest rates. Their best course, he counsels, is to ensure macroeconomic and financial stability. Just as inflation hurts the poorest most, so do recessions and crises.

The PBoC has more targeted tools at its disposal. Yet even in China many economists see structural monetary policy as a mistake. In an essay on the monetary-policy framework, Yiping Huang, Tingting Ge and Chu Wang, three academics, say there is no convincing evidence that it works. More credit is not always a solution, they say: if farmers do not receive enough, it may be because they are deemed too risky relative to the interest rates on loans. Stimulating competition among lenders, or liberalising interest rates, would be better. More broadly, argues Yu Yongding, a former member of the PBoC's monetary-policy committee, the solution to social ills is not

more lending, but a system of better-targeted taxes and subsidies, something only governments can do. This is an argument that applies as much to the case of racial inequality in America, and to housing disparities in New Zealand.

For central banks, meanwhile, the problem of tackling a structural problem with a cyclical tool is that it creates a tension between achieving its main mission and fixing social ills. When inflation was low, it was possible for the Fed to run the economy hot to bring disadvantaged workers into the labour force. But as inflation rises those good intentions could make the central bank slower to ensure its target is reached. According to Bloomberg News, even officials at New Zealand's Treasury advised the finance minister against changing the RBNZ's remit. The central bank, they concluded, would be unlikely to raise rates to reduce house prices, because their goals of maximum employment and inflation must always come first. ■



社会问题

当央行成为一站式政策商店

中央银行面临治愈社会弊病的压力【专题《央行》系列之一】

贫富之间的巨大差距让全世界的政治家都头疼不已。2019年，美国白人家庭平均每收入1美元，黑人家庭平均仅收入51美分。白人家庭每拥有1美元财富，黑人家庭只拥有15美分。拜登上任总统时承诺要解决这种差异，并发誓“所有人的公平梦想不会再推迟”。在新西兰，总理杰辛达·阿德恩承诺“让拥有房屋再次成为可能”。房价在2021年上涨了25%以上，使得在主要由富裕国家组成的经合组织俱乐部中，新西兰成为房价最难以负担的国家之一。“还有人纯粹因为住房危机想离开新西兰吗？”一位买家在论坛上问，“这个房地产市场糟透了。”在中国，贫富差距显著，社会流动性放缓，促使国家主席习近平去年发起了一场“共同富裕”运动，目标对准科技公司和名人等等。

中央银行看起来近乎同样关心收入分配问题。根据国际清算银行（BIS）维护的一个数据库，去年央行行长的演讲中有十分之一出现了与不平等有关的词，而金融危机前这一比例约为2%。（相比之下，提及通货膨胀的变少了。）根据哈弗福德学院的卡罗拉·康塞斯·宾德（Carola Conces Binder）和宾夕法尼亚大学沃顿商学院的克里斯蒂娜·帕拉洪·斯基纳（Christina Parajon Skinne）的研究，2021年美联储发表的研究论文中约有15%研究了不平等问题，而2005年时还只有约5%。

对不平等的更多关注，部分反映了对“央行通过保持低利率和推高资产价格而加剧不平等”这种论点的回应。但央行也面临着采取更多措施来直接纠正不平等和其他社会弊病的呼声。它们有时也会亲自承担社会角色。最近在美国、中国和新西兰的经历提供了例证。

在美国，进步派民主党人呼吁美联储解决就业、收入和财富方面的种族差距。2021年4月，众议院金融服务委员会通过了一项法案，提议美联储修改其使命，要求其以物价稳定和最大就业为目标，并增加试图消除种族差

距的要求。马萨诸塞州参议员伊丽莎白·沃伦（Elizabeth Warren）说：“系统性种族主义和不平等不是自然发生的事情——它是特定政策选择的结果，美联储必须采取刻意行动来解决它。”

研究表明，黑人工人从长期扩张中受益最多。黑人失业率不仅总是高于白人失业率（目前的差距约为三个百分点），而且在经济不景气的时期往往上升得更快。随着劳动力市场收紧，被排除在外的工人被吸引进来，差距开始缩小。这表明，如果货币政策保持宽松的时间更长，它将促进平等。当美联储2020年审查其战略时，通胀看起来还很低，于是它拥抱了这个想法，将其最大化就业的目标重新定义为“基础广泛且具有包容性”。美联储主席杰罗姆·鲍威尔说：“这一变化反映了我们相信强劲劳动力市场带来的好处，特别是对许多中低收入社区而言。”

| 赌上房子

2021年，在成为首个设立通胀目标的央行31年后，新西兰储备银行成为第一个将房价纳入其职权范围的中央银行。与在其他富裕国家一样，央行被视为房地产繁荣的重要贡献者。根据财政部长的指示，并受制于其主要的通胀和就业目标，新西兰联储现在必须“考虑房价”以及政府让首次购房者买得起房的目标。

相比之下，中国人民银行长期以来有着多重目标。其中最主要的是货币和经济稳定。但政府也要求其改善经济结构、实施改革和提高家庭福利。自2014年以来，中国人民银行实施了“结构性货币政策”，通过补贴性贷款工具针对不同部门提供信贷，以提振特定领域的经济，同时又不会加剧过度扩张的国有企业的债务问题。根据其货币政策报告，截至2021年6月，中国已发放近1.5万亿人民币贷款，用于支持农村发展、中小企业和扶贫。国际货币基金组织中国代表团团长赫尔格·伯格（Helge Berger）说，推动向小企业提供贷款也支持了更广泛的共同富裕运动，提高了就业率，从而提高了家庭收入。

许多经济学家怀疑这些尝试能否成功。一个问题是利率是一种钝器。宏观大锤要发挥大作用，必须用很大的力气，但这样做可能会砸坏其他东西。

智库布鲁金斯学会的斯蒂芬妮·阿伦森（Stephanie Aaronson）等人的一项研究表明，缩小黑人和白人男性失业率之间的差距需要美国的总体失业率下降到1%。纽约联储经济学家的另一篇论文表明，降息一个百分点可以将黑人和白人工人的失业率差距缩小不到0.2个百分点。要抹平差距将需要利率下降十个百分点以上。哪怕这一点能够实现，它也会导致经济过热并引发严重的通货膨胀。

哈佛大学的拉里·萨默斯（前财政部长）说，将货币政策与不平等联系起来的经济学“混乱不清”。他之前曾谈到“思想觉醒”的央行行长忽视通胀上升的危险。宽松货币必然会提振资产价格——而白人拥有这些资产的份额超出了人口比例。纽约联储的研究人员发现，降息导致白人家庭财富大幅增加，远远超过了失业率下降和收入增加对黑人家庭的影响。高通胀往往对社会中最贫穷的人影响最大。美联储经济学家的另一项研究表明，黑人家庭更容易受到通胀飙升的影响，因为他们消费了更多价格波动剧烈的商品。两个研究都表明，提高而不是降低利率将是缩小差距的一种方式。加息还是降息也是新西兰联储面临的难题。它可以提高利率以压低房价，但这会拖累经济，从而削弱潜在购房者的收入。

关于低利率是否会导致不平等也存在争议。新西兰联储行长阿德里安·奥尔（Adrian Orr）指出，全球储蓄过剩（压低了全球利率）以及住房供应不足是房价暴涨的原因，而央行只扮演了“一个小角色”。国际清算银行负责人奥古斯丁·卡斯滕斯（Agustin Carstens）表示，央行面对低利率的副作用几乎束手无策。他建议，央行最好的行动方针是确保宏观经济和金融稳定。通货膨胀对最贫困的人群伤害最大，衰退和危机也一样。

中国人民银行手头有更多针对性的工具可用。然而，即使在中国，许多经济学家也认为结构性货币政策是错误的。在一篇关于货币政策框架的文章中，三位学者黄益平、葛婷婷和王初表示，没有令人信服的证据表明它有效。他们说，更多的信贷并不总是一个解决方案：如果农民没有得到足够的信贷，可能是因为银行认为他们相对于贷款利率而言风险太大。刺激贷方之间的竞争或放开利率会更好。更广泛地说，中国人民银行货币政策委员会前成员余永定认为，解决社会弊病的办法不是增加贷款，而是制定更

有针对性的税收和补贴制度，而这只有政府才能做到。这一论点同样适用于美国的种族不平等和新西兰的住房差距。

与此同时，对于央行而言，使用周期性工具解决结构性问题的弊端在于，它要在实现其主要使命和解决社会弊病之间拉扯。当通胀处于低位时，美联储有可能给经济加热以将弱势工人带入劳动力市场。但随着通胀上升，这些善意可能会拖慢央行确保实现自身目标的速度。据彭博社报道，甚至新西兰财政部的官员也建议财政部长不要改变新西兰联储的职权范围。他们得出的结论是，央行不太可能通过加息来降低房价，因为其关于最大化就业和通胀的目标必须始终放在首位。■



Schumpeter

How much of a risk is opacity for China's Shein?

The TikTok of frocks is the world's hottest fashion retailer

IF YOU FANCY a look into the razzmatazz-filled future of e-commerce, type #Sheinhaul into TikTok, suspend your ethical scruples, and watch young influencers tear open boxes of garments, yell things like “My Shein order is here...holy shit!”, and then pour hundreds of dollars-worth of cheap garments over their heads. It’s hype, for sure, but not entirely frivolous. Shein, a Chinese online retailer, is the TikTok of the \$1.5trn apparel industry. It is one of two Chinese firms (ByteDance, TikTok’s owner, is the other) to be privately valued at \$100bn or more. Like TikTok, it is an obsession of Gen Z-ers in their teens to late 20s. And yet it is so opaque that even the American investment funds that back it, such as Tiger Global and General Atlantic, won’t divulge a thing about it. Could it be that it wants to keep its Chinese heritage under wraps?

In America, where it faces an incumbent that is almost impregnable, Amazon, its success is extraordinary. In the first three months of 2022, it accounted for almost a third of fast-fashion sales in the country, more than stalwarts Hennes & Mauritz (17%) and Inditex’s Zara (10%) combined, according to Earnest Research, a consultancy (Amazon does not break out its own apparel sales). Although Shein’s sales growth slowed from triple digits to 35% year-on-year in the quarter, it still bucked the trend: fast-fashion sales excluding Shein (and Amazon) fell by 12%. Morgan Stanley, a bank, forecast in October that Shein could become the world’s largest apparel retailer this year, with annual sales of \$20bn. Not bad for a company that came out of nowhere a decade ago. It publishes no financial data, so profitability is a secret. But a recent report said it is closing in on Amazon as America’s second-most-popular shopping app, leapfrogging

Shopify, a platform for individual brands, and Walmart, a retailing behemoth. For all the air of mystery, the company is worth examining not just as a harbinger of the future of fast fashion, but of online shopping in general.

What distinguishes it? In a nutshell, Shein (pronounced Shee-in) looks like a hybrid of two of the most successful forces in online retail—customer-obsessed Amazon and data-obsessed China. Like Amazon, it uses low prices to lure customers, and seeks to keep them constantly engaged—even compulsively so—while operating with ruthless efficiency. Yet it is China that provides the alchemy. Though it is not a big seller there, it has introduced the speed and effervescence of Chinese e-commerce to the outside world in three ways: via an integrated supply chain; data-driven design; and a grasp of the social-media hype cycle. These are what mainly sets it apart from its Western competitors. Even Amazon, which looks dowdy by comparison, could learn a thing or two.

Start with the supply chain. Based in Guangzhou, Shein taps into thousands of suppliers that stitch and sew garments. Standard stuff in the world's factory. What makes it different is that it pays them on time, which foments trust, enabling it to commission small orders at low prices, bolstering the frequency with which it can launch new styles. Sheng Lu, of the University of Delaware, calculates that last year Shein offered 1.3m new styles in America, versus 35,000 at Zara and 25,000 at H&M. He says typically Shein's prices were 40-60% cheaper. That combination of limitless variety and skimpy prices is at the heart of its business model.

Second, the suppliers are harnessed together by Shein's own software, which provides them with constant updates, measured by algorithm, of what is hot or not. That enables them to adjust output constantly to suit the latest tastes, without amassing unwanted inventory. Shein's international data-gathering, from scouring social-media sites, is crucial. It doesn't

obsess over what season it is or what's on the catwalk. Instead, writes Packy McCornick, a business blogger, "it's a mirror that reflects each country's current style back to it." Like TikTok, it doesn't seek to impose a cultural stereotype (least of all a Chinese one) on the markets where it sets foot. Surveys suggest few of its shoppers know—or even care—where it comes from.

Third, it is a master of what Allison Malmsten of Daxue Consulting, a China-focused market-research firm, calls "gamification"—another feature of e-commerce in China. She describes browsing Shein's app as like walking through a shop, not scrolling down an Amazon page. Discounts crop up at random, giving a sense of excitement. Micro-influencers, supported by small inducements, promote discounted products. She likens it to the way that Zara pioneered fast fashion on Western high streets in the 1990s, with short supply chains, high turnover and new designs. "Shein is the online version of that—on crack," she says.

For all its strengths, Shein generates a wide variety of questions—mostly because of its lack of transparency at a time when fast-fashion firms are under intense pressure to open up, particularly about their supply chains in China. There have been on-again, off-again rumours about an initial public offering. While Shein remains private, its commitment to sustainability, working conditions in its factories and sourcing of raw materials is relatively unknown. As a Chinese firm, its gathering of data, especially those of young shoppers, may arouse concern in the West. Its success itself poses a conundrum. Surveys suggest Gen Z-ers are motivated to reduce their environmental footprint. And yet Shein's performance is an indication that bargain-basement prices exert as much pull as ever.

| *Rags to riches*

As for the future, much depends on how robust its growth-first, profits-later financial model is. One message from its jet-propelled ascent is that

barriers to entry, even in countries dominated by Amazon, are not prohibitively high, provided you get the technologies right. That works both ways; Shein itself is not impervious to competition. But while people are paying fortunes just to dump its stuff on the floor, it can afford itself a smile of satisfaction—even if an overly shy one. ■



熊彼特

不透明对中国的Shein是多大的风险？

这个服装界的TikTok是世界上最火的时装零售商

如果你想一窥电子商务那令人眼花缭乱的未来，可以在TikTok上输入“#Sheinhaul”，把道德上的顾虑暂搁一边，看着年轻网红们扯开衣服的包装盒，大叫着“我在Shein下的单到啦……我了个去！”再看他们把这几百美元的平价服装一股脑倒在自己头上。炒作是肯定的，但也不是全然无聊透顶。在价值1.5万亿美元的服装行业里，中国的在线零售商Shein就相当于其中的TikTok。中国有两家估值不低于1000亿美元的私人公司，其中一家就是Shein（另一家是TikTok的所有者字节跳动）。和TikTok一样，Shein也让十几岁到二十好几的Z世代欲罢不能。然而它却如此不透明，连投资它的美国投资基金——例如老虎全球（Tiger Global）和泛大西洋投资集团（General Atlantic）——都不肯透露一星半点关于它的信息。难道说它是想隐藏自己的中国血统？

在美国，面对几乎坚不可摧的老牌公司亚马逊，它取得的成功非同凡响。根据咨询公司Earnest Research的数据，2022年前三个月，它占了美国快时尚销售额的近三分之一，超过了老资格品牌H&M（17%）和Inditex旗下的Zara（10%）的合并份额（亚马逊不公布自己的服装销售额）。尽管Shein本季度的销售额同比增长从之前的三位数放缓至35%，但仍逆流而上：除去Shein和亚马逊，快时尚销售额总体下降了12%。摩根士丹利去年10月预测，Shein可能在今年成为世界上最大的服装零售商，年销售额达200亿美元。对于一家十年前还名不见经传的公司来说这成绩不俗。它不公布财务数据，因此它的盈利能力是个秘密。但近期一份报告称，它超越了个人品牌平台Shopify和零售巨头沃尔玛，紧追亚马逊，成为美国第二大最受欢迎的购物应用。尽管这家公司笼罩着神秘的色彩，但仍值得探究一番，因为它不仅预示着快时尚的未来，也预示着整个在线购物的未来。

它是靠什么脱颖而出的呢？简而言之，Shein（发音是Shee-in）看起来就像在线零售领域最成功的两股力量的结合体——顾客至上的亚马逊和醉心

数据的中国。和亚马逊一样，它用低价吸引顾客，并设法让他们不断（甚至是强迫性地）上线，同时以极致的效率运营。不过提供炼金术的是中国。尽管它在中国不是个大卖家，但它通过三种方式让外界见识了中国电子商务的速度和活力：供应链一体化、数据驱动设计，以及深谙社交媒体炒作周期。这些就是将它跟西方竞争对手区别开来的主要因素。即使是亚马逊（相形之下就有些老土）也可以跟它学一两招。

先从供应链说起。总部设在广州的Shein找到了成千上万服装供应商。这在中国这个世界工厂属于标准操作了。Shein独树一帜的一点是，它按时支付货款，从而建立起信任，让它能以低价委托生产较小的订单，也就提高了推出新款的频率。据特拉华大学的陆圣计算，去年Shein在美国推出了130万个新款，相比之下Zara推出了3.5万个，H&M推出了2.5万个。他说Shein的售价通常要比那两家便宜40%到60%。品种超多和价格超低的结合是其商业模式的核心。

第二，Shein用自己的软件统领各路供应商，依据算法的衡量结果，不断向它们更新什么火、什么不火的信息。这使它们能够不断调整产量，以顺应人们最新的喜好，避免累积不必要的库存。Shein通过搜索社交媒体网站在全球范围内搜集数据，这一点至关重要。它不纠结现在是哪一季或是T台上展示了什么。相反，商业博客作者帕基·麦考密克（Packy McCormick）写道，“它是一面镜子，映照出各个国家当前的流行风格。”和TikTok一样，它不试图将某种文化成见（尤其是中国的）强加给所涉足的市场。调查显示，它的顾客中几乎没人知道——甚至在乎——Shein来自哪里。

第三，正如专注研究中国市场的咨询公司博圣轩（Daxue Consulting）的艾莉森·马尔姆斯滕（Allison Malmsten）所说，Shein是“游戏化”的大师，这是中国电子商务的另一个特征。她形容浏览Shein的应用就像在逛一家商店，而不是在亚马逊上向下翻页面。随机跳出的折扣给人一种兴奋感，还有拿小额赞助的小网红们推销打折产品。她把Shein和Zara相提并论——上世纪90年代，Zara凭借供应链短、库存周转率高和设计新颖开创了西方主要商业街上的快时尚。“Shein是这种做法的在线版，而且是打

了兴奋剂的那种。”她说。

尽管Shein有诸多优势，但它也生出各种各样的问题——主要是因为缺乏透明度，而快时尚公司时下正承受着被要求开放信息的巨大压力，尤其是关于它们在中国的供应链。IPO的传闻时有时无。只要Shein还是家私营企业，它对可持续发展、工厂工作条件和原材料采购的承诺相对来说就还是无从知晓。作为一家中国公司，它对数据（尤其是年轻消费者的数据）的收集可能会在西方引发关切。它的成功本身就提出了一个难题。调查显示，Z世代有动力减少他们的环境足迹。然而Shein的业绩也表明，极低廉的价格一如既往地有着强大的吸引力。

| 从破衣到华服

至于未来，很大程度上就要看Shein先增长、后盈利的财务模式有多稳健。它一飞冲天式的增长传递出的一个信息是，只要你把技术做对了，即使是在亚马逊占据主导的国家，准入壁垒也不是高得不可跨越。反之，Shein自己也并非不受竞争的影响。但是，只要人们一掷千金，只为把它那里买的东西哗啦啦全摊在地板上，它就还是可以露出一个满意的微笑——即使是个十分羞赧的微笑。■



Schumpeter

Elon Musk's Twitter saga is capitalism gone rogue

The world's richest man is playing with the rules of the game

IDA TARBELL, author of an exposé of the Standard Oil Company in 1904, described its founder, John D. Rockefeller, as “the most successful man in the world”. By that she meant “the man who has got the most of what men most want”. These days Elon Musk fits that description to a tee. Not only is he worth more than God. He invents things that are changing the world, from electric cars to space rockets. A word from him—on anything from crypto to meme stocks—turns retail investors into slobbering Pavlovians. With millions of adoring fans, he is an idol of modern capitalism.

He is also a shaper of capitalist trends, and that is where the problem lies. His fetish for Twitter—first as a megaphone to promote himself and his companies and now as a plaything that he has offered \$43bn to buy—is taking the world of business in a reckless new direction. Call it GameStop for gazillionaires. Like last year's craze for the American games retailer (“Gamestonk!!” as Mr Musk called it), he promotes the idea that the normal rules of investment do not apply. He paints stewards of fair play—regulators and boards—as pettifogging enemies of progress. And he idealises surreal narratives over economic facts. Such mischief-making has hitherto mostly been confined to the fringes of finance. In his pursuit of Twitter, Mr Musk is taking it into the mainstream.

He has brought the whiff of the meme stock to Twitter, not your usual microcap candidate for meme-ification. Before Mr Musk revealed a stake in excess of 9% on April 4th, the social-media platform was the sort of business attractive only to true believers or contrarians. Its advertising revenue has never come close to its potential. Despite its name recognition, it has been a lacklustre investment. Now Mr Musk has cast his bid to take it

private as a move to protect free speech, rather than to make money. Presumably, that appeals to his fan base. Day-traders are already piling in on his coat-tails; their share of Twitter's float has risen from 8% to 13.3%, according to Vanda Research, an investment adviser. Option trading has spiked, as has discussion of Twitter on forums like Reddit's WallStreetBets. It could just be harmless fun. However, it could also play into Mr Musk's hands. Individual investors are likelier to support his tactics than the institutional old guard.

Such tactics reek of populism. In effect, they seek to diminish institutions while elevating Mr Musk's own stature as Twitter's saviour. That includes bating those tasked with ensuring that such takeovers are done fairly and transparently, chiefly the Securities and Exchange Commission (SEC), America's market regulator, and Twitter's board. Mr Musk still publicly berates the SEC over a \$40m settlement that he and Tesla agreed to pay in 2018 regarding a tweet he sent saying he could take the electric-car company private. In his recent Twitter investment, a class-action lawsuit alleges that he violated an SEC rule by not revealing the stake within ten days of it exceeding 5%. As for the board, since it introduced a "poison pill" on April 15th, setting penalties if he lifts his stake above 15%, he has hit back. He has tweeted a poll that purports to show his followers are heavily in favour of shareholders deciding whether Twitter should be taken private, not the board. He has also noted how few Twitter shares board members own.

For all this impishness, his tactics also trample on the principle that markets need reliable information to function correctly. Fuelling the ongoing guessing game about his intentions, he has tweeted a reference to Elvis Presley's "Love Me Tender", implying—at least to those blessed with meme-stock intuition—that he may try to sidestep the board by launching a tender offer to all shareholders. Then again, he may not be serious about buying Twitter. "I'm not sure if I will actually be able to acquire it," he said

in a TED interview recorded shortly after he had made his bid on April 14th. For any other suitors circling Twitter, reportedly including two private-equity groups, Thoma Bravo and Apollo Global, this could be a stumbling block. While Mr Musk remains a shareholder, his unpredictability makes him a poison pill of his own.

The impression that if you are the world's richest man you can have fun with the rules of the game is one thing. As problematic is the idea that Mr Musk might end up controlling one of the world's most powerful means of communication at a time when fortunes are won and lost on "story stocks"—those driven by narratives discussed on forums like Twitter. Mr Musk knows all about the power of the platform. No CEO has the Twitter presence that he does. He has an army of 82.6m followers, many of whom have helped amplify his tweets promoting Tesla, making the site in effect the main marketing department for the \$1trn company. Tesla, which on April 20th reported record sales in the first quarter, goes from strength to strength. Twitter helped fuel its rise.

It may not be just his Twitter "fanboys" who have bolstered the Tesla narrative. According to David Kirsch of the Robert H. Smith School of Business at the University of Maryland, tweets generated by "fanbots", or what he claims are pro-Tesla algorithms, accounted for 23% of all messages on Twitter containing the hashtag #TSLA between 2010 and 2020, or 36,000 tweets. The findings are still under review, and do not include comparisons with other firms' fanbots over the same period. But widespread use of fanbots could suggest that Twitter has even greater power to blare out corporate propaganda than previously assumed.

| *Citizen Musk*

Propaganda is not a word widely associated with business. The world has plenty of reasons to worry about politicians buying media assets to peddle ideologies. Less so tech titans. Amazon's Jeff Bezos, for instance, is thought

to be an arm's-length owner of the Washington Post. Mr Musk is more complicated. What he builds is the work of genius. But when it comes to Twitter, he is often childish and capricious. Imagine if Rockefeller had bought himself the Twitter of his era. He, too, would have had fanboys. And Tarbell's exposé might have been trolled out of existence. ■



熊彼特

马斯克的推特大戏是资本主义“脱序”

世界首富正在玩弄游戏规则

艾达·塔贝尔（Ida Tarbell）在1904年写书揭露了标准石油公司（Standard Oil Company）的黑幕，她称该公司创始人约翰·戴维森·洛克菲勒（John D. Rockefeller）是“世界上最成功的人”。她这话的意思是“他拥有最多人们梦寐以求的东西”。如今这句话用在马斯克身上是再合适不过了。不只是因为他比上帝更有分量。从电动汽车到太空火箭，他的多项发明正在改变世界。他关于加密货币、网红股，或者别的什么东西的随便一句话都能让散户投资者条件反射般地趋之若鹜。他拥有数以千万计的追随者，是现代资本主义的偶像。

他也深刻影响着资本主义的发展趋势，这就是问题所在。他对推特的迷恋——起初是把它当作个人和公司宣传的传声筒，现在则是一件他出价430亿美元收购的大玩具——正把商界带上一个肆意妄为的新方向。可以称之为巨富们的“游戏驿站”（GameStop）。就像在去年引发对这家美国游戏零售商的狂热那样（马斯克称之为“Gamestonk!!”），他鼓吹惯常的投资规则已不再适用。他把公平竞争的管理者——监管机构和董事会——描绘成叽叽歪歪、阻碍社会进步的人。他美化超现实叙事，置经济事实于不顾。这种捣乱行为迄今大多只限于金融领域的边缘地带。而在追逐推特的过程中，马斯克正让这种行为成为主流。

他把散户神股的风气带到了推特，这可不是常见的“微型股网红化”对象。在马斯克于4月4日透露自己持有超过9%的推特股份之前，这家社交媒体平台还是那种只对忠实信徒或逆向思维者有吸引力的企业。它在广告收入上一直都没有兑现潜力。尽管知名度很高，但它一直是个乏善可陈的投资对象。如今，马斯克已出价要将它私有化，号称是为了保护言论自由而不是为了赚钱。这想必是他的粉丝群爱听的。日间交易者已经开始借着他的光纷纷买入；据投资顾问公司万达研究（Vanda Research）称，他们在推特已发行股票中的份额已经从8%上升到13.3%。期权交易暴涨，社交平台

Reddit的WallStreetBets板块等论坛上对推特的讨论也大幅增加。这些或许只是无害的乐子。不过却也可能正中马斯克的下怀。个人投资者比保守的机构投资者更有可能支持他的做法。

这些做法散发着民粹主义的气息。实际上，它们在把马斯克本人推到推特救世主之位的同时，还在试图削弱机构的地位。这包括削弱那些负责确保此类收购公平透明地进行的机构，尤其是美国市场监管机构证券交易委员会（SEC）和推特的董事会。马斯克仍在就2018年的一项和解协议公开炮轰SEC，当时他发了一条推文说自己可能会把特斯拉私有化，最后他和特斯拉被罚款4000万美元。在他最近对推特的投资中，他还面临一起集体诉讼，指控他违反SEC的规定，没有在10天之内披露自己持股比例已超过5%。至于推特董事会，它在4月15日启动“毒丸计划”，如果马斯克增持股份到15%以上便会受到处罚。马斯克已经开始反击。他在推特上发起了一项投票，声称投票结果显示他的追随者非常支持由股东而非董事会来决定是否应将推特私有化。他还指出，董事会成员持有的推特股票非常少。

撇开所有这些捣蛋行为不谈，他的做法也是对市场需要可靠信息才能正常运转这一原则的践踏。他在推文中提及猫王的歌名《温柔地爱我》（Love Me Tender），暗示（至少在那些有幸拥有神股直觉的人看来）他可能会向所有股东发起要约收购（tender offer），从而绕开董事会。这更让人们津津乐道于他此番收购到底是要做什么。不过话说回来，他可能也没有真心想要收购推特。“我不确定我是否真能买下它。”他在4月14日出价后不久录制的一期TED访谈中说道。这对其他有意收购推特的公司——据说包括两家私募股权集团Thoma Bravo和Apollo Global——可能是一个绊脚石。尽管马斯克仍是股东，但他的反复无常也让他成为自己的毒丸。

如果你是世界首富，就可以将游戏规则玩弄于股掌之上——除了给人这样的印象，同样糟糕的一点是，在一个财富围绕“叙事股”（由推特等论坛上谈论的故事推动的股票）起落的时代，人们认为马斯克有朝一日可能会控制推特这个世界上最强大的沟通手段之一。马斯克太清楚这个平台的力量了。没有哪个CEO有他在推特上这样的地位。他拥有8260万人的粉丝大军，其中许多人帮助放大了他推销特斯拉的推文的声量，使得推特实际上

成了特斯拉这家市值一万亿美元的公司的主要营销部门。特斯拉在4月20日的报告中称，第一季度的销量创下历史新高，生意节节攀升。其中推特功不可没。

帮助支撑了特斯拉叙事的可能不仅仅是他在推特上的“迷弟”。据马里兰大学史密斯商学院（Robert H. Smith School of Business）的大卫·基尔希（David Kirsch）称，2010年至2020年期间，由“僵尸粉”或他称之为挺特斯拉的算法所发布的推文就有36,000条，在推特上所有包含“#TSLA”标签的推文中占23%。这一调查结果仍在审议中，其中没有将特斯拉与其他公司同一时期的机器人粉丝做比较。但机器人粉丝的广泛使用可能表明，推特在企业宣传方面的能力比人们之前设想的还要大。

| 公民马斯克

“宣传”一词并不广泛与商业连接在一起。这个世界有充分的理由担心政客购买媒体资产来兜售意识形态。而如果是科技巨头，担心就没那么多了。例如，亚马逊的杰夫·贝索斯虽是《华盛顿邮报》的所有者，但人们认为他与该报的运作保持着距离。马斯克要更复杂些。他打造了天才之作。但一到推特上，他常常表现得幼稚又任性。想象一下，如果洛克菲勒给自己买了一个他那个时代的推特会怎样。他也会有自己的迷弟。而塔贝尔的揭露可能已经在喷子们的围攻下销声匿迹。■



Alternative energy

Sensors that scavenge their power are all the rage

They can run on light, heat and even vibrations

PERCHED AS IT is above a harbour on the Dingle peninsula, on Ireland's Atlantic coast, Mike Fitzgerald's office has an unparalleled view of the domain he hopes to conquer: the open sea. As founder and boss of Net Feasa, a name derived from the Irish word for knowledge, Mr Fitzgerald's ambition is to fit a sensor to each of the millions of shipping containers that are moving around the world. By using these to track the locations of, and conditions experienced by, those containers, and transmitting that information back to the people who need to know via satellite when a container is at sea and via a mobile-phone network when it is in port or on land, he believes firms will be able to maximise the efficiency of supply chains.

And supply-chain oversight is but one of the benefits small, remotely connected sensors can bring. People already interact with many of them—sometimes knowingly, such as those in smart watches, sometime less so, such as those which regulate temperature and lighting in their offices. Some folk, indeed, talk grandly of the result being an interconnected network akin to an “internet of things” (IoT).

Whether or not that comes to pass, there will be a lot more such sensors in the future. In 2017, researchers at ARM, a chipmaker, predicted that the world would have a trillion of them by 2035. Even more sober estimates run into the tens or hundreds of billions. And they will all need power. Lest battery-makers start rubbing their hands in glee at this new market, though, Mr Fitzgerald, and others like him, have a different idea. Their version of this future will not be battery powered. Instead, the sensors populating it will scavenge for a living.

Net Feasa is building sensors to do just that. They are powered by vibrations, heat and light, using technology developed in collaboration with Mike Hayes of the Tyndall National Institute, in Cork. The electricity thus generated is then stored in devices called supercapacitors, whence it is instantly available. Only in case of dire energy starvation need the system call on the backup battery installed in it. As a consequence, that battery should never need replacement. All of this is packed into a device a few centimetres across, which is designed to fit unobtrusively on a shipping container's doors. And these devices are already proving themselves in early trials.

| *Secret source*

Net Feasa is not alone. Sensors that draw power from the environment, either to supplement a battery or to replace it, are starting to spread. Managers at EnOcean, a German company that is one of the leading firms in the field, estimate that some 20m of the firm's products have been installed in a million buildings around the world.

The most advanced are those that use light. Their power-packs are similar to solar cells, but are adjusted to cope with the fact that the artificial interior lighting they are scavenging is both weaker than sunlight and of a different colour. Such photovoltaic sensors are used to measure levels of illumination, temperature, air pollution and even (of particular interest at the moment) airborne pathogens. Automatic systems fed these data can then adjust lighting, heating, ventilation and air-conditioning levels appropriately.

Photovoltaic sensors can also track products on assembly lines and monitor quality during manufacture. They offer eyes and ears in sterile chambers and provide early warning of shortages or leaks. They generate vast quantities of data as well, which can be used to maximise efficiency—though firms that employ them in this way tend to be secretive

about the details. A study published in 2019 on the industrial applications of all sensor types in Germany, Switzerland and Austria by EY, a consultancy, estimated the combined boost to revenue from their extensive deployment could be as high as 34%, depending on the sector involved.

Obviously, photovoltaic harvesting has restrictions, for it is suitable only in places where the lights are usually on. That works for offices and those parts of factories where people operate. But for many industrial applications, especially those being carried out in the dark, a more useful source of scavenged energy is heat. The trick of turning this into electricity was discovered two centuries ago, and has been improving ever since. It usually involves a device called a thermocouple, made of sheets of two appropriate materials laid face to face. When one side is hotter than the other, electrons move between the sheets, generating a current.

| *Turning up the heat*

One firm which makes energy-harvesters that work this way is Perpetua Power, in Oregon. Its devices are designed for inaccessible locations where battery replacement would be impractical. Perpetua's sensors have been installed on oils wells in the freezing conditions of Alaska and the desert heat of California, to measure the pressure at the well heads. They have, as well, been fitted to steam-flow gauges under the streets of New York, to make sure customers are billed correctly for their use of the city's district-heating system.

ABB, a Swedish-Swiss firm, also makes temperature sensors that rely on thermoelectric harvesting. Customers in the food industry use it to ensure ovens are sufficiently hot, while owners of industrial plants can check their cooling systems are working properly. And thermal harvesters can even be embedded in the concrete foundations of buildings, or affixed to internal beams, to flag up structural weaknesses and mechanical problems.

Another field in which energy-scavenging sensors are being deployed is transport. It is here that vibrations and movement come into their own. Perpetuum, a firm spun out of the University of Southampton, in Britain, in 2004, and bought in 2021 by Hitachi Rail, designs sensors powered by piezoelectricity. This is a phenomenon whereby certain materials generate current when stressed or deformed. Perpetuum's products monitor the condition of railway rolling stock—an abundant source of vibration. Sensors installed in wheels, gearboxes and motors are able to assess those components' health by looking out for thermal and vibrational telltales of mechanical defects. They can also watch the condition of the track. Several countries' railway networks make use of them to varying degrees, including those of America, Australia and India.

| *Shake, rattle and roll*

ReVibe Energy, a Swedish firm, has similar aims. Its sensors, which rely on electromagnetic induction rather than piezoelectricity to convert vibrations into energy, can be fixed to carriage wheels to monitor their position as well as the stresses on their bearings. ReVibe's technology is being applied to mining as well, to look out for unusual patterns of movement in machines involved in the crushing and transport of aggregates.

There is also one further source of movement, which might be exploited to run sensors. This is the human body itself, which it is becoming increasingly fashionable to adorn with sensors. A plausible way to convert body-movement into electricity is to employ devices called triboelectric nanogenerators (TENGs). These convert friction into electricity using a method that goes back at least as far as the Ancient Greeks, namely rubbing together two so-called triboelectric materials (amber, the Greek word for which is elektron, and wool were once popular) to create a static charge. TENGs turn this party trick into a useful resource by conducting the charge

so generated away as a current.

TENGs, invented a mere decade ago, might plausibly be incorporated into sensors attached to human bodies or clothing. Bodies are continuous generators of motion, whether from breathing, gesticulating or running for a bus. The flexibility of many triboelectric materials makes them ideal for sewing into fabrics, where they could harvest the body's movement in order to power sensors that monitored vital statistics such as breathing and pulse rate during exercise. Such sensors might also do well in the hands of clever marketing types, with the phrase "batteries not included" being not a warning but a boast. ■



另类能源

自采能量的传感器风头正盛

它们可以利用光、热、甚至振动来运行

迈克·菲茨杰拉德（Mike Fitzgerald）的办公室俯瞰爱尔兰大西洋沿岸丁格尔（Dingle）半岛的一个港口，视野无与伦比，尽揽他想要征服的对象——公海。作为Net Feasa（这个名字源于爱尔兰语的“知识”一词）的创始人和老板，菲茨杰拉德的雄心是给漂在世界各地的数以百万计的集装箱全部装上传感器。他打算用这些传感器来跟踪集装箱的位置和运输情况，并将这些信息发送给有需要的人：如果集装箱在海上，就通过卫星发送信息，在港口或陆地上就依靠移动电话网络。他相信这将让企业能够最大限度地提高供应链的效率。

监督供应链只是可远程连接的小型传感器带来的众多好处之一。日常生活中人们已经在和许多传感器打交道，有时是有意识地，比如和智能手表中的传感器，有时则没太留意，比如办公室里调节温度和照明的传感器。有些人已经在大谈特谈类似于“物联网”（IoT）的传感器网络。

无论这是否会成真，未来这类传感器的数量会大幅增加。2017年，芯片公司安谋（ARM）的研究人员预测，到2035年，全球将有一万亿个此类传感器。即使更冷静的估计也认为会有几百亿到几千亿个。而它们都需要用电。不过，电池制造商们先别激动有了一个新市场，菲茨杰拉德和其他像他一样的人有不同的想法。在他们所展望的未来中，大量传感器并不是由电池供电的，而是自己采集能源来维持运行。

Net Feasa正在打造这样的传感器。它们由振动能、热能和光能来驱动，用的是与廷德尔国家研究所（Tyndall National Institute，位于爱尔兰科克[Cork]）的迈克·海耶斯（Mike Hayes）合作开发的技术。如此产生的电力被存储在称为超级电容器的设备中，随时可用。只有在能量极度匮乏的情况下，才需要系统启用安装在其中的备用电池。因此，这样的传感器永远无需更换电池。整个传感器只有几厘米大，可以毫不起眼地装在集装箱

的门上。这些设备已经在早期试验中得到了验证。

| 秘密电源

Net Feasa并非独行军。从环境中获取能量以补充或替代电池的传感器正开始普及。德国EnOcean是该领域里的领先公司之一，其管理人员估计，公司已有约2000万个传感器安装在全球各地的一百万栋建筑物中。

最先进的是利用光的传感器。它们的电源组类似于太阳能电池，但经过了调整，以利用比太阳光弱、光色也不同的室内人造光源。这种光伏传感器可用于测量照明、温度、空气污染，甚至空气中的病原体（这在目前尤其令人感兴趣）。然后，接收了这些数据的自动系统可以适当地调整照明、供暖、通风和空调。

光伏传感器还可以跟踪装配线上的产品并在制造过程中监控质量。它们在无菌室中充当耳目，在出现材料短缺或泄漏时发出预警。它们还会生成大量数据，可用于最大限度地提高效率，只不过做这类部署的公司往往对细节保密。咨询公司安永于2019年发表了一项对德国、瑞士和奥地利的所有类型传感器的工业应用的研究结果，估计广泛部署这类传感器总体上提升了营收，幅度因行业而异，在有些行业可能高达34%。

显然，光伏有其局限性，因为它只适用于照明常开的地方。这在办公室和工厂中有人员操作的区域没有问题。但在许多工业应用场景中，尤其是黑暗的场景中，更有用的能量来源是热能。将热转化为电的技术发现于两个世纪前，此后不断改进。它通常要用到一种称为热电偶的装置，由两种合适的材料层层相向铺设。当一侧比另一侧更热时，电子在两层之间移动，就产生了电流。

| 调高热量

位于俄勒冈州的Perpetua Power就是一家生产热能采集传感器的公司。它的传感器专为人迹罕至、无法更换电池的地方而设计。该公司的传感器已安装在阿拉斯加冰天雪地中和加利福尼亚炎热沙漠里的油井上，用以测量井口压力。纽约市地下供热管网的蒸汽流量计上也安装了Perpetua的传感

器，以确保居民使用区域供热系统期间不会出现计费错误。

瑞典瑞士合资公司ABB也生产依赖采集热电的温度传感器。有了这种传感器，食品行业的客户可以确保烤箱能达到足够的温度，工厂的所有者可以检查冷却系统是否在正常运行。采集热电的传感器甚至可以嵌入建筑物的混凝土地基中，或固定在内部横梁上，以发现结构缺陷和力学问题。

另一个正在部署能量采集传感器的领域是交通运输。在这个领域，振动和移动产生的能量可以发挥作用。Perpetuum是一家2004年从英国南安普敦大学（University of Southampton）分离出来的公司，在2021年被日立轨道（Hitachi Rail）收购，它设计由压电驱动的传感器。压电是某些材料在受压或变形时产生电流的现象。Perpetuum的产品被用于监测铁路车辆的状况，这些车辆能够提供丰富的振动能。安装在车轮、变速箱和电机中的传感器能发现机械缺陷导致的发热和振动，据此评估这些部件是否正常。它们还可以观察轨道的状况。美国、澳大利亚和印度等国的铁路网络都在不同程度上使用了这些传感器。

| 摇摇晃晃向前进

瑞典公司ReVibe Energy也有类似的目标。它的传感器通过电磁感应而非压电将振动能转化为电能，这些传感器可以固定在车轮上，监测车轮的位置及轴承上的应力。该公司的技术也被应用于采矿业，以发现用于破碎和运输矿料的机器出现异常运动模式。

还可以利用另一种动能来驱动传感器。那就是人体本身，把传感器穿戴在身上日益流行。将身体运动转化为电的一种可行方法是使用称为摩擦电纳米发电机（TENG）的设备。它们可将摩擦产生的机械能转化为电能，所用的方法至少可以追溯到古希腊时期，具体来说就是将两种所谓的摩擦起电材料（比如曾经很流行用羊毛和琥珀，后者在希腊语中叫elektron，是英语单词“电”的词源）相互摩擦以产生静电荷。TENG把如此产生的电荷作为电流传导出去，把这种最初在派对上玩的小戏法便变成了一种有用的能源。

十年前才发明的TENG也许可以被整合到传感器中，再把传感器附着在人体或衣服上。无论是在呼吸、打手势、还是追公交车的时候，身体都会持续产生动能。许多摩擦起电材料都是柔性的，非常适合缝制到织物中，这样就可以穿在人身上收集身体的动能，为在运动中检测呼吸和脉搏等生命数据的传感器供电。这种传感器在聪明的营销人员手里可能会大卖，他们可以把“不含电池”这句提醒直接拿来做广告语啦。 ■



The hesitant v the urgent

China's two-front fight to quash the virus and revive its economy

GDP held up in the first quarter, but retail sales slid in March

THE FORTUNES of the world's second-biggest economy hinge on two kinds of hesitancy. The first is over vaccines. China's elderly are surprisingly reluctant to get inoculated against covid-19. That has saddled the country with a vulnerable population that could die in large numbers if the government abandons its controversial "zero-covid" policy. But this uncompromising stance, which tries to stamp out any outbreak of the virus, obliges China to impose ruinous lockdowns on some of its most productive cities, including Shanghai, where some residents have been confined to their homes for over 30 days.

These limits on movement are wreaking economic havoc. Even before the worst restrictions were imposed, retail sales shrank by 3.5% year-on-year in March (in nominal terms), according to figures released on April 18th. Catering services fell by more than 16%. Unemployment in China's 31 biggest cities is now 6%, higher than in 2020, points out Zhang Zhiwei of Pinpoint Asset Management. Overall GDP grew surprisingly fast, by 4.8% in the first quarter, compared with a year earlier. But that was mostly because of strength in the first two months of the year.

This quarter could look decidedly worse. Ting Lu of Nomura, a bank, thinks GDP could shrink. China's rulers are not hiding their concern. Earlier this month Li Keqiang, the prime minister, told local authorities that they should show greater "urgency" in stabilising the economy.

Yet a second kind of hesitancy has marked the government's response to the slowdown: a reluctance to stimulate the economy as forcefully as in the past. On April 15th the People's Bank of China (PBoC) said it would reduce

the amount of money that banks must hold in reserve. But it cut these requirements by only 0.25 percentage points for most banks, half as much as expected. And it has still not lowered its key policy rates since January, before the latest covid outbreak took hold. Instead this macro-institution has resorted to micro-management, issuing no fewer than 23 instructions to encourage lending for particular purposes, such as elderly care, transport and grain purchases.

What is holding the PBoC back? It says it will “refrain from a deluge of strong stimulus policies” and “strike a balance between internal and external equilibria”. It may worry that the monetary easing required to preserve growth would jeopardise China’s external balance with the rest of the world. In particular the PBoC may fear that capital would flee if it cut interest rates too boldly just as America’s Federal Reserve raises rates sharply. China has already suffered net capital outflows from its equity markets in recent months, as Russia’s invasion of Ukraine forced foreign investors to face up to geopolitical dangers they would rather not contemplate.

If China remains hesitant to ease monetary policy more dramatically, it must rely on fiscal stimulus. But even here, it faces impediments and reluctance. The finance ministry, for example, still has a prudish unwillingness to report a big headline budget deficit. Hence much of the extra public spending needed to stabilise growth this year will be carried out by local governments and special funds that do not appear in the headline figures.

Unfortunately, local authorities are themselves under renewed financial scrutiny. Last July, the banking regulator issued “Document No. 15” instructing banks not to increase the hidden debts of local governments. These rules were later shelved. But the threat of a future crackdown remains. Another directive issued by the finance ministry required local

governments to pick spending projects more carefully if they wished to finance them with bonds.

Despite these intrusions, local governments probably have enough money as a group, reckons Hui Shan of Goldman Sachs, a bank. They have carried over unspent funds from last year and received transfers from the central government. But the money is not evenly spread. “Some provinces have projects but no money, others have money, but no projects,” she says.

In those parts of the country battling covid, the limits on stimulus may be logistical rather than financial. Lockdowns and other restrictions interfere with the manpower and supply chains necessary for public construction projects. Fighting covid may also monopolise officials’ attention. Yes, local officials are being urged to stabilise the economy with “urgency”. But they are also being sacked for losing control of the virus. That skews incentives towards cutting infections rather than expanding infrastructure. It is hard to be a covid hawk and a fiscal dove.

It is possible for stimulus to bypass such bureaucracy. In America fiscal easing took the form of “stimmy” cheques paid directly to households. China lacks an equivalent system for distributing government largesse. The next best thing, in theory, is cutting income taxes, which leaves more money in people’s pockets to spend. But as only a minority of Chinese pay income tax, such cuts would have little impact. The closest alternative is lower taxes on smaller firms, some of which are not much more than household operations anyway. Thus about a third of fiscal easing this year will take the form of cuts in taxes and fees for small and medium-sized enterprises, according to Goldman Sachs.

Again, however, covid poses an obstacle. The retailers and other small enterprises targeted by these tax cuts are often the same firms hit hardest by lockdowns and other restrictions. If the zero-covid policy deprives a

firm of its customers, relieving it of taxes is scant consolation. A company with zero income does not care what tax rate it pays.

China may therefore have to wait until this covid wave subsides before it can revive its economy in earnest. And even then, it must hope that the economic comeback is not immediately halted by another outbreak. Until China's elderly become less hesitant about vaccines, its economy will stay resistant to stimulus.

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急惊风遇上慢郎中

中国抗疫与救经济的双线作战

第一季度GDP保持增长，但3月零售数字下滑

世界第二大经济体在两方面行动迟疑，令其自身未来面临考验。首先是疫苗。中国的老人出人意料地不愿接种新冠疫苗。在这种情况下，假如政府放弃备受争议的“清零”政策，一个高危人群可能大量死亡。但这种试图扑灭一切疫情火苗的强硬立场迫使中国对一些最富生产力的城市实施破坏性的封城措施，包括上海，那里一些居民已被封禁家中超过30天。

这些限制人们行动的措施正在引发经济灾害。4月18日公布的数据显示，即使在最严厉的限制措施实施之前，3月的零售额已同比萎缩3.5%（按名义价值计算）。餐饮业收入下降超过16%。保银资产管理公司的张智威指出，中国31个最大城市的失业率目前达6%，高于2020年的水平。GDP总量增长却是速度惊人，第一季度同比增长4.8%，但这主要反映的是今年头两个月的强劲表现。

本季度的情况可能会明显恶化。野村证券的陆挺认为GDP有可能萎缩。中国官员也没有掩饰担忧。本月早些时候，总理李克强指示地方政府要在稳定经济方面增强“紧迫感”。

然而，在应对经济放缓上，政府表现出了第二种迟疑：不愿像过去那样大力刺激经济。4月15日，中国人民银行表示将下调金融机构存款准备金率。但对大多数银行的降准幅度仅为0.25个百分点，只是预期的一半。而且，自1月（最近一波疫情爆发之前）以来，人行一直没有下调关键的政策利率。相反，这一宏观政策机构转而采取微观管理手段，发布了多达23项举措鼓励特定用途贷款，如养老机构、运输物流和粮食采购。

人行何以动作克制？它表示将不会出台大量强刺激政策，以及要“把握好内部均衡和外部均衡的平衡”。它可能是担心保持增长所需的宽松货币政策会危及中国与世界其他国家的外部平衡，尤其是在美联储大幅加息之

际，人行担心自己太过大胆降息会导致资本外逃。近月来，随着俄乌战争的爆发迫使外国投资者正视之前不去考虑的地缘政治风险，中国股市已出现资本净流出。

如果中国还是对加大力度放松货币政策迟疑不决，那就必须依靠财政刺激了。但即使在这个环节，它也不无障碍和不情愿。比如，财政部仍循规蹈矩小心翼翼，不想要通报一个庞大的总体预算赤字。因此，今年稳定增长所需的大部分额外公共开支将由地方政府和专项基金承担，不会出现在总体预算数字里。

不幸的是，地方财政也在经历新一轮审查。去年7月，银保监会发布“15号文”，禁止银行新增地方政府隐性债务。这些规定后来被搁置。但未来仍存在收紧的风险。财政部发布的另一指引要求地方政府在使用债券融资时必须更审慎地选择支出项目。

高盛的闪辉认为，尽管有这些干扰，地方政府总体上应该尚有充裕资金，既有去年未用的资金转结，又有中央政府的转移支付。但各地宽裕程度不一。“一些省份有项目但缺资金，另一些有资金缺项目。”她说。

在忙于抗疫的地区，限制了经济刺激的可能是后勤而非财政。封控等限制措施影响了公共建设项目所需的人力和供应链。官员们也可能在一门心思抗疫而无暇他顾。地方官员的确是被敦促要对稳定经济增强“紧迫感”，但他们也因“抗疫不力”而被撤职。这就使得他们更着力减少感染数字而非扩大基建。既要强硬抗疫，又要积极刺激经济，这可不容易。

绕过这样的官僚主义实现经济刺激是有可能的。在美国，财政宽松是通过向家庭直接派发“刺激性”支票的形式实现的。中国缺乏类似的机制来分政府礼包。理论上，次选办法是削减所得税，让人们口袋里有更多闲钱可以消费。但在中国，需要缴纳个人所得税的人口属于少数，这样的减税影响不大。最接近的替代方案是给小公司（其中一些差不多也就是家庭作坊式的）减税。所以高盛预测，今年的财政宽松约三分之一将以削减中小企业税费的形式实现。

然而，疫情仍然构成障碍。作为这些减税优惠对象的零售商及其他小企业往往也是受封城等限制措施影响最大的公司。如果清零政策导致企业没了顾客，那减轻税负也起不了什么作用。一家零收入的公司是不会在意税率高低的。

因此，中国可能不得不等待这一波疫情消退后才能真正重振经济。而就算到那个时候，也还得祈望经济复苏不会因为又一波疫情戛然而止。在中国的老年人不再对打疫苗那么犹疑之前，中国的经济将继续抗拒被刺激提振。





Fixing wounds

Never mind stitches—it is possible to solder wounds closed

It works exactly the same way that soldering electronics does

IF YOU CUT yourself, your options are to reach for a plaster or, if the cut is nasty, to go to a doctor to have it stitched or glued. That seems a rather limited choice. Medical researchers have been trying to develop another way to join the edges of a wound, inspired by something routinely done to gas pipes and electronics: soldering. And an innovation developed at the Swiss Federal Institute of Technology (ETH) in Zurich, in co-operation with the Swiss materials-science institute Empa, suggests this might soon become a practical reality.

In soldering, an intermediate material is heated until it melts and bonds with the two surfaces that are to be joined. The material of these edges has a higher melting point and remains solid (otherwise it would count as welding).

For tissue, the intermediate material is not a metal alloy, but a paste of biocompatible material, such as albumin, a protein that is an important constituent of blood. When heated, the paste develops chemical bonds with living tissue on both sides. As healing progresses, the two sides reconnect and the paste is removed by the body's natural cleaning procedures.

Closing wounds by soldering has several important advantages, says Oscar Cipolato, a PhD candidate at ETH, who presented preliminary results on April 5th at the Photonics Europe conference in Strasburg, France. The bond it produces is strong and watertight, something that cannot be guaranteed with stitches. If a wound is internal—after surgery, for instance—a leak could cause an infection.

But soldering tissue has turned out to be difficult in practice, which means it is not commonly done. Heating the soldering paste is done by shining a laser onto it, from which the paste absorbs energy. But controlling the heating precisely is tricky. The paste needs to reach about 80°C to work. If the temperature is too low, the soldering material will not fully melt and the bond will be weak. But if it is too high, it risks burning the surrounding tissue. Existing attempts at wound-soldering rely on thermal imaging to measure temperature. But that only measures the temperature at the surface of the solder, rather than throughout the material.

Mr Cipolato and Inge Herrmann, a chemical engineer at ETH, hope their improved paste can get around such problems. It is made up of two kinds of nanoparticles, specks of material of only about 20-billionths of a metre across. Between them, these help direct the energy of the laser to the places it should be, and help doctors gauge the conditions in the paste.

The first set of particles are made of titanium nitrate. They eagerly absorb photons of red or near infrared light, precisely the colours that most easily penetrate living tissue, and release the energy as heat to their surroundings. That efficient absorption means the paste can be heated by a relatively weak laser beam, which helps protect the surrounding tissues.

Using such tiny particles is in itself not new. But until recently most researchers used tiny rods of gold, which are expensive. Nanoparticles of titanium nitrate, on the other hand, are easily and cheaply produced by spraying the right mix of precursor chemicals into a flame.

The second set of particles are a new development in the soldering world. They are specks of a material which fluoresces. In other words, it absorbs the laser light, but immediately re-emits the energy as light again, at a few very specific wavelengths.

Two of these wavelengths are also in the infrared and red colour range. That allows some of the re-emitted light to emerge from the paste to where it can be analysed by an external instrument called a spectrometer. By precisely measuring the difference between the two wavelengths, the temperature of particles that are emitting it—and thus of the paste as a whole—can be worked out.

Thus far, the researchers have tested the technique only on pieces of pig intestine that they obtained from a slaughterhouse. Soldering a cut is done in a matter of minutes. Similar “ex vivo” tests of the strength and permeability of the bond will also be needed for human tissue, followed by clinical tests on actual pigs and, eventually, humans. But the researchers are optimistic. At the conference, they were cagey about exactly what the fluorescing particles are made of. They are applying for a patent, which could be quite valuable if the tools at the ready in a doctor’s office one day include a laser soldering gun. ■



修复伤口

不用怕缝针了，现在可以焊接伤口

其工作原理和钎焊电子器件一模一样【新知】

如果你被割伤了，一般会找张创可贴，如果伤口比较严重，就去找医生给你缝合或粘合。选择似乎不多。医学研究人员正在尝试开发另一种闭合伤口的方法，这种方法已广泛应用于燃气管道和电子器件，那就是钎焊。位于苏黎世的瑞士联邦理工学院（Swiss Federal Institute of Technology，简称ETH）与瑞士联邦材料科学与技术研究所（Empa）合作研发的一项创新表明，这可能很快会变得现实可行。

钎焊的原理是加热中间材料使其熔化，与要连接的两个表面结合。这些表面材料的熔点较高，在加热时保持固体状态（否则就是熔焊了）。

在人体组织上，所用的中间材料不是金属合金，而是由生物相容性材料制成的焊膏，例如白蛋白——这种蛋白质是构成血液的重要成分。焊膏加热后，会与两侧的活体组织形成化学结合。随着伤口逐渐愈合，两侧组织将重新连接起来，而焊膏则通过人体的自然净化过程被清除。

4月5日，在法国斯特拉斯堡召开的欧洲光子学大会（Photonics Europe）上，ETH的博士生奥斯卡·奇波拉托（Oscar Cipolato）介绍了初步研究成果，指出通过钎焊闭合伤口有几个重要优点。这种结合方式很固密而不怕水，这是缝合无法保证的。如果伤口深入体内，比如术后伤口，沾水有可能导致感染。

但钎焊人体组织实际操作起来难度很大，所以这种方法不常用。加热焊膏需要用激光照射，使焊膏吸收能量。但要精准控制加热并不容易。焊膏需要加热到80℃左右才能发挥作用。如果温度不够，焊膏就不会完全熔化，导致结合力变弱。但如果温度过高，又可能灼伤周围组织。已有的钎焊伤口的尝试使用热成像来测量温度。但这只能测量焊膏的表面温度，而不是它的整体温度。

奇波拉托和ETH的化学工程师因格·赫尔曼（Inge Herrmann）希望通过改良焊膏来克服这类问题。这种焊膏由两种纳米颗粒组成，粒径仅有200亿分之一米。两种颗粒共同作用，可以引导激光的能量去往该去的位置，并帮助医生测量焊膏的状态。

第一种颗粒由硝酸钛制成。它们积极吸收红光或近红外光（这些光最易穿透活体组织）的光子，并将能量以热的形式释放到周围环境中。高效的吸收能力意味着只需要相对较弱的激光束就能加热焊膏，有助于保护周围组织。

使用这样的微型颗粒本身并不是新鲜事。但直到不久前，大多数研究人员还在使用昂贵的微型金条。而硝酸钛纳米颗粒容易生产，成本也很低，只需要把调配好的化学前体喷洒到火焰上即可制备。

第二种颗粒是钎焊界的一项新进展。它们是一种荧光物质的微粒。换句话说，这种物质吸收激光，但随即又以光的形式把吸收的能量释放出去，而且集中在几个特定的波长上。

其中两个波长也属于红外光和红光范围。这使得焊膏重新发出的光线可以用一种叫光谱仪的仪器从外部加以分析。通过精密测量这两个波长之间的差异，可以计算出发光颗粒的温度，进而得知焊膏的整体温度。

到目前为止，研究人员只在从屠宰场获得的猪肠上测试了这种方法。钎焊一个切口在几分钟中内就能完成。还需要对人体组织进行类似的“离体”结合强度和渗透性测试，然后在活猪身上开展临床试验，最后是人体试验。但研究人员很有信心。在会议上，他们对荧光颗粒的具体成分讳莫如深。他们正在申请专利，如果有一天医生诊所的常备工具里多了一把激光焊枪，这个专利将相当有价值。■



The next wave of outsourcing

A half-a-trillion-dollar bet on revolutionising white-collar work

Digitisation of everything, cloud computing and hybrid working is fuelling a boom in Indian IT consulting

TWO DECADES ago India's information-technology (IT) firms were the stars of the rising country's corporate firmament. The industry's three giants, Tata Consultancy Services (TCS), Infosys and Wipro, became household names at home and familiar to chief executives of big businesses abroad, who had outsourced their companies' countermeasures against the feared "millennium bug", expected to wreak havoc on computers as the date changed from 1999 to 2000, to Indian software engineers. By the mid-2000s the Indian IT trio's revenues were growing by around 40% a year, as Western CEOs realised that Indian programmers could do as good a job as domestic ones or better, at a fraction of the price. Then, following the global financial crisis of 2007-09, revenue growth slowed to single digits. For years afterwards the stars seemed to be losing some of their shine.

Now they are back in the ascendant. Having declined as a share of GDP between 2017 and 2019, exports of Indian software services ticked up again as the world's companies turned to them for help amid the disruption to operations and IT systems wrought by the pandemic. In the last financial year they reached an all-time high of \$150bn, or 5.6% of Indian GDP (see chart). NASSCOM, a trade body, expects the industry's overall revenues to grow from \$227bn last year to \$350bn by 2026.

In the 12 months to March sales at TCS, Infosys and Wipro are once again forecast to grow by double digits—this time from a much higher base than 20 years ago. All told, they could rake in nearly \$60bn next year, up from just over \$40bn in 2019 (see chart 3). In the past two years they have added an astonishing 200,000 or so people to their combined workforce, which

now numbers nearly 1.1m. Add the Indian businesses of big Western IT-services firms such as Cognizant (which is based in New Jersey but India-focused), IBM and Capgemini, as well as smaller Indian rivals and around 1,600 “captives”, as in-house Indian operations of foreign firms are known, and the headcount rises to 5m.

Both revenues and ranks of Indian IT look poised to keep growing briskly. Lalit Ahuja, who runs a firm that helps set up captives, says a new one opens every other week. TCS, the industry’s brightest star, reckons that its sales will rise from nearly \$30bn today to \$50bn before 2030. The company is eyeing 1m employees. Infosys and Wipro have comparable ambitions. And investors are buying it. The stockmarket value of the big three has doubled to \$330bn since covid-19 first emerged. With the addition of Cognizant and Tech Mahindra, another Indian firm, the figure is around \$400bn (see chart 4). This represents a huge bet on the future of white-collar jobs.

Three global forces lie behind Indian IT’s sparkling outlook. All manner of businesses are digitising ever more of their operations. They are moving more activities to the computing cloud. And work is becoming more remote. India’s low-cost, competent coders can help with all three.

Start with digitisation. The pandemic has turbocharged efforts by companies of all stripes to make their businesses more agile, efficient and clever. Retailers have introduced kerbside pickup. Clinics have launched digital doctor’s appointments. Schools have run online classes. Factories have been kitted out with sensors to allow remote monitoring in the absence of workers, locked down at home. Data from covid-19 vaccine trials have been crunched. All these innovations required sophisticated software. A lot of it has been developed in India since early 2020. And there is more to come. Among Infosys’s projects are several connected to electric cars (including software for the vehicles themselves and for petrol stations to

offer charging).

The corporate great migration to the cloud offers further opportunities. According to Anuj Kadyan of McKinsey, a consultancy, big ones include supervising the migration itself for clients, ensuring that the new cloud operations are cyber-secure and adding advanced cloud-based data analytics and artificial intelligence (AI) on top. Earlier this year JPMorgan Chase, an American bank, announced it would add 6,000 people to its substantial Indian business to work on the cloud, cyber-security and AI. IBM has opened a cyber-security centre in India to cater to its Asian clients.

Combined, digitisation and the cloud make it possible for companies to untether from their physical headquarters not just peripheral functions but parts of their ever more digital core business. Many have done just that during the pandemic, thanks to remote work. This opens up the third opportunity for India's IT consultants. They could assume some of the core corporate roles from white-collar workers in the rich world. Wages for new hires in India can be as little as \$5,000 annually, less than a tenth of the going rate in rich countries. Even factoring in other costs, Indian projects are at least 20% cheaper than the same endeavours in the West, estimates Peter Bendor-Samuel, boss of the Everest Group, a consultancy.

A ballooning Indian "talent cloud", as TCS calls it, is the biggest opportunity of all. It is also the most uncertain. Some Western companies are having second thoughts about hybrid work (which requires at least partial presence in the office), let alone the fully remote sort. Indian wages are also beginning to rise. India's IT giants and captives are competing for the best and brightest among themselves, as well as with a vibrant startup scene. McKinsey estimates that compensation costs have risen by 20-30% over the past year. Company executives say it is not uncommon for employees to ask for their wages to be doubled. Attrition at the big firms has spiked.

As the nature of outsourced work changes, the Indian advantage may erode further. It is easier for clients to outsource standardised assignments on the periphery of corporate functions to faraway India. It is harder to do so for high-value projects at the heart of their business, which require constant communication, continuity and confidentiality. For these reasons, proximity matters. At the very least, it means being in the same time zone as your client. Infosys and TCS now operate in more than 40 countries. Infosys has more than 30 outposts across America and is building a new \$245m campus in Indiana polis. The firm plans to add 10,000 American workers in the next few years, bringing the total to 35,000. “We needed capacity closer to the customers,” explains Ravi Kumar, who oversees Infosys’s global services business. Mr Kumar’s own job has relocated from Bengaluru to New York.

Still, India accounts for the bulk of its IT firms’ workforce. Although the companies are cagey about where their employees are based, securities filings by Infosys and Cognizant show that, give or take, three-quarters of staff are based in India. If India’s entire IT industry grew at the same rate as TCS, more or less doubling its workforce this decade, that could mean nearly 5m new Indian white-collar jobs—and potentially 5m fewer in the West.

This points to a final hurdle. Amid supply-chain disruptions from the pandemic, now compounded by Russia’s war in Ukraine, and a geostrategic contest with China, the West is in a protectionist mood. Few politicians would relish millions of well-paid positions moving to India on their watch. Critical visas that once allowed the Indian firms to send star employees abroad to work directly with clients have already grown harder to come by, forcing these positions to be filled locally. Although data can in theory be stored and analysed anywhere, governments are increasingly keen to limit cross-border information flows, often invoking national security. By building a few more campuses in Western countries India’s IT

titans may alleviate some of those concerns. They are unlikely to make them disappear. ■



下一波外包浪潮

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万物数字化、云计算和混合工作正推动印度IT咨询业繁荣发展

二十年前，印度日益崛起，而信息技术（IT）公司是其企业苍穹中的明星。该行业的三大巨头塔塔咨询服务（TCS）、印孚瑟斯（Infosys）和威普罗（Wipro）在本国成为家喻户晓的名字，也为国外大企业的CEO们所熟知。他们把寻找对策灭掉令人担忧的“千年虫”的任务外包给了印度的软件工程师（当时人们认为随着日期从1999年变为2000年，千年虫会给计算机造成严重破坏）。过程中，西方的CEO们意识到印度的程序员可以和自己国家的程序员做得一样好，甚至更好，而工资只相当于国内员工的一小部分。于是，到2005年前后，印度IT三巨头的收入已经在以每年40%的速度增长。之后经历了2007到2009年的全球金融危机，它们的收入增长放缓至个位数。随后的多年里，这些明星的光芒似乎黯淡了一些。

现在，它们又开始重新升上高空。在2017年至2019年期间，印度软件服务出口占GDP的比重下降，但接下来，新冠疫情开始扰乱企业的运营和IT系统，世界各地的公司向它们求助，推动了这块出口再次回升。在上一个财年，这部分的出口额达到了1500亿美元的历史最高水平，相当于印度GDP的5.6%（见图表1）。行业组织印度国家软件和服务公司协会（NASSCOM）预计，到2026年，该行业的总收入将从去年的2270亿美元增长至3500亿美元。

在截至今年3月的12个月中，TCS、印孚瑟斯和威普罗的销售额预计将再次以两位数增长，而且这一次的基数比20年前高得多。三家公司加起来，明年可能会获得近600亿美元的收入，高于2019年的400亿美元出头（见图表3）。过去两年，它们的员工总人数惊人地增加了约20万人，目前接近110万人。加上西方大型IT服务公司的印度业务，如高知特（Cognizant，总部位于新泽西州，但业务重点在印度）、IBM和凯捷（Capgemini），再算上较小的印度竞争对手，以及外国公司设在印度的约1600个内部技术部门（captives），员工总数就上升到了500万。

印度IT业的收入和从业人数看起来都将保持快速增长。拉利特·阿胡贾（Lalit Ahuja）经营着一家帮助企业设立captive的公司，他说每隔一周就新开张一间。业内最耀眼的明星TCS估计，其销售额将在2030年之前从目前的近300亿美元增至500亿美元。该公司考虑将员工扩充到100万人。印孚瑟斯和威普罗也有差不多的雄心。投资者也很买账。自新冠肺炎出现以来，三巨头的市值已经翻了一番，达到3300亿美元。加上高知特和另一家印度公司马衡达（Tech Mahindra），这一数字约为4000亿美元（见图表4）。这表示投资者对白领工作的未来押下了巨大的赌注。

印度IT业闪亮前景的背后有三大全球力量在推动。各种各样的企业都在不断扩大自身业务的数字化。它们正在把更多的活动转移到计算云上。此外，工作也变得越来越远程化。印度收费不高又能干的码农在这三个方面都能提供帮助。

先看数字化。疫情已推动各种公司加大马力，力图使自身业务更敏捷、高效和巧妙。零售商推出了路边自提服务，诊所上线了数字医生预约，学校开设了在线课程。工厂配备了传感器，可以在工人被封锁在家而不能在场的情况下实行远程监测。新冠疫苗试验产生的数据已经被分析处理。所有这些创新都需要高精尖的软件。印度自2020年初以来研发了很多这样的软件，接下来还会贡献更多。印孚瑟斯的先进软件项目中有几个与电动汽车有关，包括汽车本身的软件和协助普通加油站提供充电服务的软件。

企业向云的大迁移提供了更多机会。咨询公司麦肯锡的阿努伊·卡德扬（Anuj Kadyan）称，大的机会包括替客户监督迁移过程本身，确保新的云操作符合网络安全要求，并在其上添加先进的基于云的数据分析和人工智能（AI）。今年早些时候，摩根大通宣布将为其庞大的印度业务增加6000人，从事云、网络安全和AI方面的工作。IBM在印度开设了一个网络安全中心，以满足亚洲客户的需要。

数字化和云的结合使企业不仅可以从其实体总部中拆解出外围功能，也能松绑一部分日益数字化的核心业务。疫情期间由于人们改为远程办公，许多企业实际上已经在做这件事了。这给印度的IT顾问们带来了第三个机

会。他们可以从富裕国家的白领那里分走一些核心的企业角色。在印度，新员工的年薪可能只有5000美元，不到富裕国家现行水平的十分之一。咨询公司Everest Group的老板彼得·本多尔-塞缪尔（Peter Bendor-Samuel）估计，即使算上其他成本，印度的项目耗资也比西方的同类项目低至少20%。

TCS所说的印度的“人才云”不断扩大是最大的机会，但也是最不确定的。一些西方公司对混合工作（要求员工至少有一部分时间是在办公室）都开始有疑虑，更不用说彻底的远程工作了。印度的工资也已开始上涨。印度的IT巨头和captive部门不仅正在彼此争夺最优秀和最聪明的人才，还要跟红火的创业圈子抢人。麦肯锡估计，薪酬成本在过去一年已上升了20%到30%。企业高管表示，员工要求工资翻倍的情况并不少见。大公司的员工流失率已经激增。

随着外包工作性质的改变，印度的优势可能会进一步削弱。对于客户来说，把处于公司职能外围的标准化任务外包给遥远的印度还算容易。但要把处于业务核心的高价值项目外包出去难度就大了，因为这些项目需要不断的沟通、连续性和保密性。出于这些原因，位置邻近很重要，最起码也得跟客户在同一个时区。印孚瑟斯和TCS现在已在40多个国家开展业务。印孚瑟斯在美国有30多个分支机构，并且正在印第安纳波利斯新建一个造价2.45亿美元的园区。该公司计划未来几年在美国增加一万名员工，这将使当地员工总数达到3.5万人。“我们需要把一些产能放在离客户更近的地方。”负责印孚瑟斯全球服务业务的拉维·库马尔（Ravi Kumar）解释道。他本人的工作地点已经从班加罗尔转到了纽约。

尽管如此，印度IT公司的员工大部分仍然来自印度。尽管这些公司对于自己员工的工作地点讳莫如深，但印孚瑟斯和高知特的证券申报文件显示，它们差不多四分之三的员工都在印度。如果整个印度IT业都以TCS那样的速度增长，在这个十年员工数量大约翻一番，那可能就意味着印度将新增近500万个白领工作岗位——西方则可能要减少500万个。

这指向了最后一个障碍。疫情干扰了供应链，俄乌战争又进一步冲击供

应，再加上与中国的地缘战略竞争，目前西方处于保护主义情绪中。没有政客会满心欢喜地任由几百万个高薪职位在自己任内转移到印度。印度公司曾经可以获准派遣明星员工到国外直接与客户合作，现在这样的关键技能工作签证已越来越难拿到，客户只得转而在本地招人。尽管理论上数据可以在任何地方存储和分析，但政府越来越热衷限制跨境信息流动，通常以国家安全为由。印度IT巨头在西方国家多建几个园区可能会减轻这类忧虑，但不太可能使之完全消失。 ■



The new atlas

Can Silicon Valley still dominate global innovation?

Why nearly 300 cities now host more than 1,000 unicorns

TAKE AN EVENING walk on 17th Cross Road in Bengaluru's HSR Layout district, and you bump into tech types stepping out of their startup's office and into one of the local microbreweries. They might work for Udaan (e-commerce), Vedantu (education technology) or another of the growing herd of private startups valued at \$1bn, whose proliferation in the area has prompted locals to dub it "Unicorn Street". That name might be outdated, says Mohit Yadav, co-founder Bolt.Earth, a unicorn wannabe housed in the MyGate building. "Unicorn neighbourhood" would be more apt, he chuckles.

HSR Layout was not always the startup hub of Bengaluru, itself the startup capital of India. Five years ago Koramangala, a few kilometres to the north, was the place to be—until rising office prices pushed out new startups. The fact that young firms are beginning to eye an ever-wider region to set up shop hints that Bengaluru is maturing as a venue for ambitious technologists. The city is home to 26 unicorns, and last year attracted \$13bn in venture capital (VC).

For decades Silicon Valley's position as the birthplace of high-growth technology companies was unassailable. The small patch of land has given the world, among others, Hewlett-Packard (founded in Palo Alto in 1939), Intel (Mountain View, 1968), Apple (Los Altos, 1976), Google (Menlo Park, 1998) and Uber (San Francisco, 2009). Mark Zuckerberg moved in only four months after founding Facebook in Cambridge, Massachusetts, in 2004. As recently as 1999 the valley attracted a third of global VC investment. In 2011, 20 of the world's 27 unicorns had their headquarters in America, according to CB Insights, a data provider. Only four other countries boasted even one.

San Francisco is home to 136 unicorns, with 220 in the Valley as a whole, more than any other place in the world. But as Bengaluru shows, such clustering is no longer confined to a strip of land in California. Unicorns can be found in 45 countries. Over 1,000 trot the globe; nearly half are outside America. The share of all VC flowing into American startups has declined from 84% two decades ago to less than half.

The diffusion of capital reflects huge growth in tech in recent years that lifted many boats. But it will endure beyond the ups and downs of the investment cycle. Even as tech valuations slid during the fourth quarter of 2021 and first quarter of 2022, the share of funds flowing to firms outside Silicon Valley and America has remained high at 82% and 51%, respectively.

Of the places that have burst onto the startup scene, some are mature, such as Beijing, London or Tel Aviv, and often global in their ambition. Others, including Bengaluru, Singapore or São Paulo, are in earlier stages of hub-dom. All enjoy a broad pool of technical talent, deep links to other parts of the world and local risk capital. Together, they are redrawing the map of global innovation—creating one that is more dispersed, diverse and competitive.

Many of the new clusters look different from Silicon Valley—although some share its pleasant climate. They also differ from each other. The more mature hubs tend to spawn more “deep tech” firms working in complex areas like artificial intelligence and other sophisticated software aimed chiefly at corporate customers rather than consumers. But whereas Israeli and British startups often look across their borders, Beijing’s are focused almost entirely on the domestic market.

Younger innovation hubs, including Bengaluru, São Paulo and Singapore, look a bit more alike in that their focus is regional rather than global. Instead of breaking new ground they often adapt existing business models

to local market conditions. As disposable incomes rise in new regions, consumers become willing to pay for similar “technification of services”, says Peng Ong of Monk’s Hill Ventures, a Singaporean VC firm. Anand Daniel of Accel, a Silicon Valley VC firm, calls this the “X of Y” playbook. And so Flipkart (e-commerce) is the Amazon of India; Nubank (fintech) is the Revolut of Brazil; Grab (ride-hailing) is the Uber of South-East Asia. This helps explain why 70% of South-East Asian unicorns and 80% of Latin American ones are either in fintech or consumer internet (see chart). Still, hyper-localisation means each hub is distinct.

The boom in tech clusters has been fuelled by several structural developments. The worldwide spread of high-speed internet and smartphones has allowed startups to serve customers just about everywhere from just about anywhere. “Rapid technology adoption has made the market so much deeper,” says Abheek Anand of Sequoia India, the Indian arm of a Silicon Valley VC stalwart. Cloud computing and freely available developer tools have made starting a firm much easier. At the same time, as growth rates in mature markets have slowed and competition for investments has risen, venture capitalists are looking elsewhere for their next big bet.

The pandemic appetite for all things digital has fuelled these trends. Some 60m South-East Asians, nearly a tenth of the region’s population, became new netizens in the past two years alone, according to Bain, a consultancy. The number of companies in India and South-East Asia generating \$100m of annual revenue has jumped by an order of magnitude in recent years, observes Mr Anand.

If the democratisation of technology and global VC were the whole story, however, startups would be springing up everywhere. They aren’t. The Economist has looked at startup funding and valuation data for the ten countries with the most billion-dollar startups. We have found that nearly

40% of these unicorns herded in the country's top startup city. Between 2011 and 2021 the top city's share of national VC funding rose from less than 50% to nearly 70% for London, from 24% to 60% for Berlin and from 15% to 34% for Bengaluru.

| *Where to startup?*

That suggests that clustering remains no less powerful a force than when Alfred Marshall coined the notion of "agglomeration economies" in the late 19th century. Once a city gains a foothold, additional activity is pulled in because of increasing returns to scale. It is easier to do business and recruit when suppliers and talent pools are nearby. Ideas flow more easily when employees from rival firms frequent the same pubs (or microbreweries). Even wide adoption of hybrid work is unlikely to change that; people will still want to meet in person and it is easier to do this when the persons are nearby.

A deep talent pool is the most obvious ingredient of a successful cluster. Famously, Silicon Valley benefits from proximity to brain trusts such as Stanford or the University of California, Berkeley. Tel Aviv has both universities and recruiters from the Israeli Intelligence Corps, which like elite universities enlists the best and brightest. Participation in such elite units is an immediate signal for a venture capitalist looking for a startup founder to back, or a startup seeking to hire young technologists. Bengaluru has nearly 70 engineering colleges. More than 55% of Indians on LinkedIn, a professional social network, boast technical skills, such as those needed for programming. Only Germans are technically savvy; for Americans and Britons the share is around 42%. "Where else can you quickly hire a few thousand engineers?" marvels Shailesh Lakhani, a colleague of Mr Anand's at Sequoia India.

Talent alone is not enough, however. Tokyo had the brains to produce global tech giants such as Sony (in electronics) and, more recently, Rakuten

(in e-commerce). Yet the Japanese capital has struggled to nurture a vibrant startup scene. One possible reason is the continued dominance of Japan Inc by keiretsu (conglomerates). Another is the country's insularity. In one survey from 2019 the country ranked 53rd in the world in English proficiency; less than 8% of Japanese speak it fluently. Foreigners tend to have a hard time gaining status in Tokyo's business circles. Outside venture capitalists have been shunned.

That hints at the second critical factor: openness to people and ideas. Migrants are a disproportionately enterprising bunch. Around 60% of America's most valuable tech companies were started by immigrants or their children. European hubs such as Berlin, London and Paris, each of which is home to ten or more unicorns, have large immigrant populations. China lacks foreign founders but its startup hubs like Shanghai and Shenzhen draw plenty of "sea turtles", returnees who have studied or worked abroad.

It is hard to determine to what extent connectedness spurs startup activity, as opposed to the other way around. But the two go hand in hand, and almost certainly feed off each other. René Belderbos of Maastricht University has examined how often inventors in a city co-author patents with inventors abroad, and how this changes over time. Unicorn-rich Bengaluru, San Francisco, Singapore and Tel Aviv all feature in the top ten of Mr Belderbos's ranking of cities based on the growth in such linkages. Unicorn-poor Tokyo has seen a decline in connections.

Bengaluru illustrates how talent and openness combine to create startup magic. The city's fondness for newfangled technology dates back to at least 1905, when the local maharajah diverted a nearby supply of hydropower to make it the first city in Asia with electric streetlamps. Four years later it built the Indian Institute of Science, a prestigious university that remains a magnet for clever Indians. Migrants make up more than half its

population—a statistic India’s tech grandees invariably cite when explaining the city’s success.

It has also long been connected to the world. Texas Instruments, an American electronics-maker, chose Bengaluru for its first regional office in 1985. Infosys and Wipro, Indian information-technology (IT) giants based in Bengaluru since the 1980s, have served global software customers, making the city “the world’s back office”. When India’s closed economy opened up in 1991, the city was the natural place for foreign companies and capital eyeing the country’s vast market, says Nandan Nilekani, co-founder of Infosys. That in turn drew ambitious domestic upstarts seeking connections and cash.

Yet Bengaluru might not be where it is were it not for a third ingredient: the presence of local risk capital. For an enterprise to thrive, it needs backers who understand the ecosystem and are willing to feed it. This can be founders and employees of earlier startups, who become angel investors for the next generation, notes Rana Yared of Balderton Capital, a VC firm. Former employees of Flipkart, which Walmart bought in 2018, have gone on to found 225 startups, including five unicorns, according to Tracxn, a data provider. Those from Grab, Lazada and Sea Group, a trio of Singaporean tech darlings, have founded or run more than 1,000 firms.

A local capital base also encourages another important type of risk-taking. Employees must be able to leave existing firms and join or start competitors. AnnaLee Saxenian of Berkeley has argued that Boston’s Route 128, also near to top-notch universities, was outcompeted by Silicon Valley in the 1980s because it lacked this free flow of people between firms, perhaps in part because of stricter enforcement of non-compete agreements than in California.

In some cases, the state can provide early backing. Besides having a long

bench of angels that stretches back at least to Bill Hewlett and David Packard, Silicon Valley enjoyed its share of government contracts in its formative post-war years, particularly from the Defence Department. Fairchild Semiconductor, whose employees included the future founders of Intel, Sequoia Capital and Kleiner Perkins, depended on government procurement for much of its early growth. Bengaluru, home to military-research outfits, and Tel Aviv also have strong links to their countries' armed forces, which can act as buyers of first resort.

Some governments support startups with capital rather than contracts. Take Singapore, which has more unicorns per person than anywhere bar Israel. Edwin Chow of Enterprise Singapore, a government agency in charge of the city-state's startup policy, puts this down to schemes aimed at attracting investors and founders. For instance, a big programme from 2009, modelled after a similar one in Israel, matched every \$1 from investors with nearly \$6 from the public purse. At least 15 funds qualified for the scheme, which allowed the investors to buy out the government's stake at its original face value, adds Mr Ong of Monk's Hill.

How much credit such top-down policies deserve is hotly debated. Attempts to will clusters into existence have mostly foundered. In 1999 Germany poured €1.5bn (\$1.6bn) into a Bavarian cluster initiative. France funnelled a similar amount to its pôles de compétitivité in 2005. Malaysia's BioValley complex, launched the same year at a cost of \$150m, was soon derided as "Valley of the BioGhosts". A Canadian experiment in supporting startups failed because it was so well-funded that private investors stayed on the sidelines. In 2009 Josh Lerner of Harvard Business School concluded that "for each effective government intervention, there have been dozens, even hundreds, of failures, where substantial public expenditures bore no fruit".

| *There be unicorns*

Most investors and even some policymakers agree that Singapore's success has more to do with its entrepot status, pro-business laws and political stability. That said, Justin Hall of Golden Gate Ventures, a Singaporean VC firm, reckons that the leg-up from the state may have accelerated Singapore's ascent by a few years.

The importance of talent, openness and risk capital will persist. But the clusters that thrive thanks to a combination of the three will continue to evolve. As the younger clusters mature, the "X of Y" playbook will gradually give way to more advanced tech, as is happening in China. They will also become more globally minded. Already about 30% of India's current herd of 60-odd unicorns primarily target international markets, says Dev Khare of Lightspeed India Partners, one more VC firm.

And new cities may join the ranks of tech hubs. Lagos, Nigeria's commercial capital, already looks poised to become the dominant player in the African fintech scene. In March Nigerian startups were better represented than those of any other country except two at Y Combinator, a famed Silicon Valley startup accelerator. Hot technologies such as the decentralised world of cryptocurrencies and so-called Web3 may seek out places with favourable regulations (or lack thereof). FTX, a cryptocurrency exchange valued at \$32bn, has just moved to Nassau, in the Bahamas. The weather is nice there, too.

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硅谷还能主导全球创新吗？

为什么如今1000多家独角兽分布在近300个城市【深度】

晚上走在班加罗尔HSR Layout区的第17横路（17th Cross Road）上，会遇到创业公司的技术宅们从办公室里出来，走进附近的小啤酒吧。他们可能是在电子商务公司Udaan、教育科技公司Vedantu或一家别的什么创业公司工作，这些公司的估值都已达到十亿美元。像这样的私营公司在这一带的数量激增，当地人干脆把这条路叫作“独角兽街”。不过这个名字可能已经过时了，叫“独角兽社区”可能更贴切些，Bolt.Earth的联合创始人莫希特·亚达夫（Mohit Yadav）笑着说。他的公司在MyGate大楼里，正在努力跻身独角兽之列。

HSR Layout区并非一直都是印度创业之都班加罗尔的创业中心带。五年前，向北几公里处的科拉曼加拉区（Koramangala）才是创业人士的聚集地，后来这一片的写字楼价格不断上涨，把新成立的创业公司挤了出来。年轻公司开始在一个日益扩大的区域里寻找落脚点，表明班加罗尔作为一个汇聚雄心勃勃的技术人才的中心正走向成熟。这座城市拥有26家独角兽，去年吸引了130亿美元的风险投资。

在好几十年里，硅谷作为高增长科技公司发源地的地位一直不可撼动。在这一方弹丸之地诞生了惠普（1939年成立于帕洛阿尔托）、英特尔（1968年，山景城）、苹果（1976年，洛斯阿尔托斯）、谷歌（1998年，门洛帕克）和优步（2009年，旧金山）等众多科技公司。马克·扎克伯格2004年在马萨诸塞州剑桥市创立Facebook后仅四个月就搬了过来。近在1999年，硅谷还吸引到了全球三分之一的风险投资。数据供应商CB Insights的数据显示，2011年，全球27家独角兽公司有20家总部设在美国。其他哪怕只有一家独角兽的国家也只有四个而已。

现在旧金山有136家独角兽，整个硅谷有220家，比世界上任何其他地方都多。但班加罗尔的景象表明，这些公司不再仅集中于加利福尼亚的那一小

块狭长地带。如今45个国家拥有独角兽，全球共有1000多家，近一半在美国以外。流入美国创业公司的风投占全球比例已从20年前的84%下降到现在的不到一半。

资本的扩散反映了近年来科技业的巨大发展有水涨船高的效果。但这种趋势将不会受到投资周期起伏的影响。尽管科技公司估值在2021年第四季度和2022年第一季度有所下滑，期间流向硅谷和美国以外的公司的资金比例仍分别保持在82%和51%的高位。

在那些已经登上创业中心舞台的地方，有些已经成熟，比如北京、伦敦和特拉维夫，而且它们的抱负往往放眼全球。班加罗尔、新加坡或圣保罗等其他地方尚处于创业中心的早期阶段。所有这些地方都拥有大量的技术人才，并与世界其他地区以及本地风险资本深度连接。它们正在共同改写全球创新版图，让它变得更分散、多元，也更富于竞争。

许多新中心看起来和硅谷不同，尽管有些和它一样有宜人的气候。它们彼此也各不相同。更成熟的中心往往会催生更多钻研复杂领域的“深科技”公司，比如人工智能和其他主要针对企业客户而非消费者的尖端软件。以色列和英国的创业公司经常跨国发展，而中国的创业公司几乎完全专注于国内市场。

从一个方面看，班加罗尔、圣保罗和新加坡等新晋创业中心变得更相像了些：它们更聚焦一个地区而不是全球。它们通常不开辟新天地，而是根据本地市场情况调整现有的商业模式。新加坡风投公司Monk's Hill Ventures的王鹏（Peng Ong，音译）表示，随着新地区的可支配收入增加，消费者开始愿意为类似的“服务科技化”掏腰包。硅谷风投公司Accel的阿南德·丹尼尔（Anand Daniel）称之为“平移”剧本：Flipkart（电子商务）就是印度的亚马逊，Nubank（金融科技）是巴西的Revolut，Grab（网约车）是东南亚的优步。这有助解释为什么70%的东南亚独角兽和80%的拉丁美洲独角兽要么在金融科技领域，要么在消费互联网领域（见图表）。尽管如此，高度本地化意味着每个中心独具特色。

几种结构性发展推动了科技创业中心的繁荣。高速互联网和智能手机在全球范围内的普及让创业公司几乎能够从任何地方为所有地方的客户提供服务。“科技的迅速采用让市场变得深厚多了。”硅谷老牌风投公司红杉资本印度分公司的阿比克·阿南德（Abheek Anand）说。云计算和可以免费获得的开发者工具极大提高了创办公司的便捷度。与此同时，随着成熟市场增长放缓，投资竞争加剧，风投资本家正在放眼其他地方寻找下一个大赌注。

疫情之下，对各式数字产品和服务的巨大需求进一步推动了这些趋势。根据咨询公司贝恩的数据，仅在过去两年里就有大约6000万东南亚人成为新网民，占该地区人口的近十分之一。阿南德注意到，近年来，印度和东南亚年收入达到1亿美元的公司数量猛增了一个数量级。

然而，如果仅靠科技民主化和全球风险投资就足以推动发展，那么创业公司将无处不在。而事实并非如此。本刊研究了十个拥有最多独角兽的国家的创业融资和估值数据。我们发现，这些独角兽中有近40%聚集在本国领先的创业中心城市。2011年至2021年间，伦敦、柏林和班加罗尔在本国总风险投资中所占的比例分别从不足50%、24%和15%，上升至近70%、60%和34%。

| 去哪创业

这表明，和阿尔弗雷德·马歇尔（Alfred Marshall）在19世纪后期提出“集聚经济”这一概念的时候相比，集群的力量依然不减。一旦一个城市站稳脚跟，随着规模效益的增加，更多的经济活动会被吸引进来。如果附近就有供应商和人才资源，开展业务和招聘人手都更容易。如果相互竞争公司的员工经常光顾相同的酒吧（或小啤酒吧），想法就更容易流动。即使广泛采用混合式办公也不太可能改变这一点，因为人们还是会想要有面对面的时候，而如果大家都在附近要见面就更容易些。

丰富的人才资源是成功的创业中心最显而易见的要素。硅谷毗邻斯坦福大学、加州大学伯克利分校等人才济济之地，它的成功得益于此，这一点人所共知。特拉维夫既有大学，也有来自以色列情报局（Israeli Intelligence

Corps) 的招募人员，后者和顶尖大学一样，只招最优秀、最聪明的人。风投家在寻找可以投资的创业公司创始人，或创业公司寻求聘用年轻的技术人员时，此类精英机构的教育或工作背景就是最直接的信号。班加罗尔有近70所工程院校。在专业社交网络领英上的印度人中，55%以上自我介绍具备编程等技术技能。只有德国人在这方面占比更高，美国人和英国人的这一比例约为42%。“还有哪里可以一下子招到几千名工程师呢？”阿南德在红杉资本印度分公司的同事沙伊莱什·拉哈尼 (Shailesh Lakhani) 赞叹道。

然而，光有人才还不够。东京的聪明头脑创立了索尼（电子产品）和历史相对较短的乐天（电子商务）等全球科技巨头，却一直没能孕育出一个充满活力的创业中心。一个可能的原因是日本的经连会（即企业集团）一直主导着商界的发展。另一个可能的原因是日本的岛国根性。根据2019年的一项调查，日本的英语水平在全球排名第53位，能说一口流利英语的人不到8%。外国人往往很难在东京的商业圈中站稳脚跟。外来的风险资本家一直不受待见。

这就带出了第二个关键成功要素——对人和想法的开放度。移民的创业精神远胜原住国民。美国最有价值的科技公司约60%都是由移民或其子女创办的。拥有大量移民人口的柏林、伦敦和巴黎等欧洲创业中心各自拥有十家或更多的独角兽。中国缺少外国创业者，但上海和深圳等创业中心吸引了大量“海龟”。

相比创业活动促进了连通，连通在多大程度上刺激了创业难以确知。但两者紧密相关，几乎可以肯定是相互促进的。马斯特里赫特大学

（Maastricht University）的勒内·贝尔德伯斯（René Belderbos）研究了一个城市的发明人与国外发明人共同申请专利的频率，以及这种合作随时间变化的情况。在贝尔德伯斯对此类合作增速的城市排名中，盛产独角兽的班加罗尔、旧金山、新加坡和特拉维夫名列前茅。而在独角兽匮乏的东京，这种合作则呈下降之势。

班加罗尔的成功展示出人才和开放相结合能创造创业奇迹。这座城市对新

奇技术的喜爱至少可以追溯到1905年，当时地方上的王公将附近的水电供应改向，让班加罗尔成为了亚洲第一个点亮了用电的路灯的城市。四年后，那里成立了知名学府印度科学理工学院（Indian Institute of Science），至今仍吸引着聪明的印度人。移民占到班加罗尔人口的一半以上，印度的科技巨头在解释这座城市的成功时总是会引用这一数据。

班加罗尔也早早就与世界建立起了联系。美国电子制造商德州仪器（Texas Instruments）于1985年选择班加罗尔作为自己第一个区域办事处所在地。印度信息技术巨头印孚瑟斯（Infosys）和威普罗（Wipro）自上世纪80年代以来一直在班加罗尔的总部为全球软件客户提供服务，让这座城市成为“世界的后台”。印孚瑟斯的联合创始人南丹·尼勒卡尼（Nandan Nilekani）表示，当印度在1991年开放其封闭的经济时，这座城市自然成为了那些盯上该国广阔市场的外国公司和资本进入印度的首选之地。这反过来又吸引了雄心勃勃、寻求国际联系和资金的国内新贵。

然而，如果不是因为存在本地风险投资这第三个因素，班加罗尔可能不会是现在的样子。企业要蓬勃发展，需要了解生态系统并愿意为其注资的支持者。而他们可能是早期创业公司的创始人和员工，如今变成了新一代创业公司的天使投资人，风投公司Balderton Capital的拉娜·雅瑞德（Rana Yared）指出。据数据供应商Tracxn统计，Flipkart（在2018年被沃尔玛收购）的前员工已经创立了225家创业公司，其中包括五家独角兽。Grab、Lazada和Sea Group这三家新加坡科技新宠的员工已经创立或经营着1000多家公司。

本地的资本基础还鼓励了另一种重要的冒险行为。员工必须得能够离开现在的公司，去加入或开创竞争公司。加州大学伯克利分校的安娜莉·萨克森（AnnaLee Saxenian）曾指出，同样靠近一流大学的波士顿128号公路在上世纪80年代被硅谷超越，因为它缺乏公司之间的人员自由流动，部分原因可能是那里在执行竞业禁止协议方面比加州更严格。

在某些情况下，政府可以提供早期支持。硅谷拥有至少可以追溯到比尔·休利特（Bill Hewlett）和大卫·帕卡德（David Packard）的一大批天使投

资人，但除此之外，它在战后的成长期内拿到的政府合同也不算少，尤其是国防部的合同。飞兆半导体（Fairchild Semiconductor）的早期发展大多是依靠政府采购，该公司的一些员工后来成为英特尔、红杉资本和凯鹏华盈（Kleiner Perkin）的创始人。班加罗尔有军事研究机构，它和特拉维夫都与本国军队有密切的联系，军方可以成为首选买家。

一些政府是用资金而不是合同来支持创业公司。以新加坡为例，其人均独角兽数量比以色列以外的任何地方都多。负责制定国家创业政策的政府机构新加坡企业发展局（Enterprise Singapore）的周广源认为，新加坡之所以能有这样的成功，主要有赖于旨在吸引投资者和创始人的各种方案。例如，2009年启动的一个大型项目以以色列的类似政策为蓝本，投资者每投1美元，政府就匹配出资近6美元。该计划让投资者能够以原始面值购买政府的股权，至少有15只基金已获准加入，Monk's Hill的王鹏补充说。

这种自上而下的政策有多大功劳？对此争论激烈。想靠政策就打造创业中心的努力多以失败告终。1999年，德国向巴伐利亚创业中心计划投入了15亿欧元（16亿美元）。2005年，法国向其产业竞争力集群注入了类似规模的资金。同年，马来西亚启动了生物谷（BioValley），投资1.5亿美元，很快就被嘲笑是“幽灵生物谷”。加拿大支持创业公司的一项试验也失败了，原因是资金太过充足，私人投资者只能束手旁观。2009年，哈佛商学院的乔什·勒纳（Josh Lerner）得出结论，“每一次有效的政府干预背后，都会有数十甚至数百次的失败，大量公共支出打了水漂”。

| 要有独角兽

大多数投资者都认为，新加坡的成功与其转口港地位、亲商法律和政治稳定的关系更大，甚至一些政策制定者也这么看。话虽如此，新加坡风险投资公司Golden Gate Ventures的贾斯汀·霍尔（Justin Hall）认为，政府的支持可能让新加坡的崛起提早了几年。

人才、开放和风投资本将依然重要。但是，由于这三者的结合而蓬勃发展的创业集群将继续演变。随着更年轻的集群逐渐成熟，“平移”剧本将逐渐让位于更先进的技术，就像正在中国发生的那样。它们也将变得更具国际

视野。另一家风险投资公司光速印度（Lightspeed India Partners）的德夫·哈雷（Dev Khare）表示，目前在印度的60多家独角兽公司中，已有约30%主要瞄准国际市场。

新的城市可能会加入科技创业中心的行列。尼日利亚的商业中心拉各斯（Lagos）看起来已经蓄势待发，将成为非洲金融科技领域的主导者。3月，在著名的硅谷创业加速器Y Combinator，尼日利亚的创业公司数量仅次于两个国家。诸如去中心化的加密货币和所谓的Web3等热门技术可能会到法规于它们有利（或缺乏法规监管）的地方寻求发展。估值320亿美元的加密货币交易所FTX刚刚搬到巴哈马的拿骚（Nassau）。那里的气候也很宜人。





Seeing and believing

From Apple to Google, big tech is building VR and AR headsets

They might just be the next big platform after the smartphone

WITH EYES like saucers, nine-year-old Ralph Miles slowly removes his Quest 2 headset. “It was like being in another galaxy!” he exclaims. He has just spent ten minutes blasting alien robots with deafening laser cannons—all the while seated silently in the home-electronics section of a London department store. Sales assistants bustle around, advertising the gear to take home today. “That would be sick!” enthuses Ralph. “Don’t get him started,” warns his dad.

Children are no longer the only ones excited about “extended reality”, a category which includes both fully immersive virtual reality (VR) and augmented reality (AR), in which computer imagery is superimposed onto users’ view of the world around them. Nearly every big technology firm is rushing to develop a VR or AR headset, convinced that what has long been a niche market may be on the brink of becoming something much larger.

Meta, Facebook’s parent company, has sold 10m or so Quest 2 devices in the past 18 months; Cambria, its more advanced headset, is coming this year. Microsoft is pitching its pricier HoloLens 2 to businesses. Apple is expected to unveil its first headset by early 2023 and is said to have a next-generation model in the pipeline. Google is working on a set of goggles known as Iris. And a host of second-tier tech firms, from ByteDance to Sony and Snap, are selling or developing eyewear of their own.

The tech giants spy two potentially vast markets. One is the kit itself. Only around 16m headsets will be shipped this year, forecasts IDC, a data firm (see chart). But within a decade sales may rival those of smartphones in mature markets, believes Jitesh Ubrani of IDC. “Some people ask, ‘Do you

think this is going to be as big as what smartphones created?” says Hugo Swart of Qualcomm, which makes chips for both headsets and phones. “I think it’s going to be bigger.”

That points to the second, still more tantalising opportunity: control of the next big platform. Apple and Google have established themselves as landlords of the smartphone world, taxing every purchase on their app stores and setting rules on things like advertising, at the expense of digital tenants such as Facebook. Whoever corners the headset market stands to acquire a similarly powerful gatekeeping position. “It is going to be the next big wave of technology,” says Mr Ubrani, “and they all want to make sure they get a piece of that.”

The search for the next platform comes as the last one shows signs of maturing. Smartphone shipments in America fell from a peak of 176m units in 2017 to 153m in 2021, according to IDC. The advertising model that has powered firms like Facebook and Google is under attack from privacy advocates. In response, Mark Zuckerberg, Meta’s boss, has bet the future of his company on the “metaverse”. Microsoft’s CEO, Satya Nadella, has said that extended reality will be one of three technologies that shapes the future (along with artificial intelligence and quantum computing). Sundar Pichai, his counterpart at Alphabet, Google’s corporate parent, said last year that AR would be a “major area of investment for us”. Venture-capital funds pumped nearly \$2bn into extended reality in the last quarter of 2021, a record, according to Crunchbase, a data company.

Some 90% of headsets sold today are VR. Since buying Oculus, a headset-maker, for \$2bn in 2014, Meta has captured the market, with 80% of VR sales by volume in 2021. The Quest 2, which offers a convincing (if mildly nauseating) experience with no need for an accompanying computer, has been a hit since its launch in 2020, helped by lockdowns and a \$299 loss-leader price. Last Christmas the Quest’s smartphone app was the most-

downloaded in America. Smaller rivals like HTC, a Taiwanese electronics firm, and Valve, an American games developer, which make VR gear for gaming, are being squeezed. Pico, a headset-maker owned by ByteDance, TikTok's Chinese owner, is doing well in its home market, where Meta is banned.

Meta's VR strategy still revolves around ads. It is selling headsets as fast as it can in order to build an audience for advertisers, says George Jijiashvili of Omdia, a firm of analysts. Horizon Worlds and Venues, its virtual spaces for hanging out, claim 300,000 monthly visitors. To the irritation of some of them, Meta has already experimented with running ads there. The Cambria, a more expensive "pass-through" headset that combines a VR-like screen with front-mounted cameras to display footage of the world outside, will train cameras on users' faces. That will enable the capture of facial expressions in virtual form—as well as the monitoring of which ads eyeballs linger on.

Meta is also monetising its app store. From next year the market for VR content will surpass that for VR hardware, reckons Omdia. One of Mr Zuckerberg's motives for pushing the new platform is to liberate Meta from dependence on phonemakers for the distribution of its apps. The firm has become a digital landlord itself, with the power to tax Quest-store purchases in the same way that Apple and Google take a cut of smartphone app sales (Meta declines to say how much it charges).

While Meta ramps up its efforts in VR, others are experimenting with the knottier technology of AR. Unlike VR, which takes you to another place, AR is "anchored in the world around you", says Evan Spiegel, boss of Snap. His Snapchat social-media app has long provided AR filters for phones, allowing users to turn themselves into cartoon characters or virtually try on products like clothes and make-up with the help of their device's camera. Snap is now toying with hardware, building a prototype set of AR

Spectacles, which have gone out to a few hundred software developers.

Your correspondent wandered through a floating solar system and was chased around Snap's London offices by holographic zombies as he tried out the Specs, which at 134 grams look and feel like a chunky pair of sunglasses. The downside of their slender styling is a battery life of 30 minutes and a tendency to overheat. Limits in optical technology restrict the field of view to a square in the middle of the lens, meaning that overlaid graphics are seen as if through a letterbox. Snap's main reason for making the device is to discover use cases for AR headsets when they become widely adopted, says Mr Spiegel. In the hardware market, "We have a shot. But our goal is still really on the AR platform itself."

For now, AR glasses are a niche within a niche. High cost and wobbly performance limit their appeal. IDC expects industry shipments of 1.4m units this year. The top seller in 2021 was Microsoft's HoloLens 2, a \$3,500 device used by big clients including America's armed forces (whose order for 100,000 pairs provoked complaints from Microsoft staff that they "did not sign up to develop weapons"). Magic Leap, a startup in Florida, will launch the second generation of its AR glasses, with a wider field of view, in September. It is targeting industries like health care and manufacturing, rather than consumers.

Despite VR's dominance of the headset space, AR sparks more excitement about mass adoption. Even with Meta's relentless promotion of virtual concerts, office meetings and more, few people use VR for anything other than gaming: 90% of the \$2bn spent on VR content last year went on games, according to Omdia. Tim Cook, Apple's boss, has criticised VR's tendency to "isolate" the user. "There are clearly some cool niche things for VR. But it's not profound in my view," Mr Cook has said. "AR is profound." Apple has shown notably little interest in the immersive metaverse that excites Mr Zuckerberg.

Apple's upcoming pass-through headset will give a taste of the AR experience. A pair of true AR glasses are still in early development. These first products are said to be aimed at designers and other creative professionals, rather like its high-end Macintosh computers. Still, the firm's entry into the industry could prove to be a watershed. "Apple's ability to drive adoption is probably unparalleled in the market," says Mark Shmulik of Bernstein, a broker. It will hope to do brisk business in China, giving it an edge over Meta. IDC predicts that in 2026, 20m pairs of AR glasses could be shipped worldwide, making them about twice as popular as VR goggles are today.

| *Argumented realities*

The big question is whether headsets can go beyond gamers and professionals, and become a true tech platform rather than just an accessory. Today's AR and VR gear is good at solving "very specific pain-points", says Tony Fadell, a former Apple executive who helped develop the iPhone. A generalisable platform such as an iPhone "is a whole different story", he says. "And I don't believe it," he adds, at least for the next five years. In the foreseeable future, Mr Fadell thinks, headsets will be a bit like smart watches, popular but not revolutionary in the way the smartphone has been.

Mr Spiegel agrees that headsets will not fully replace phones, just as phones have not done away with desktop computers. But, he points out, "one overarching narrative is that computing has become way more personal." It has moved from the mainframe, to the desktop, to the palm of the hand. The next step, he believes, is for computing to be "overlaid on the world around you" by AR. Desktop computing was mainly about information processing, and smartphones were mainly about communication. The next era of computing, he suggests, will be "experiential".

In this scenario headsets could be part of a broader ecosystem of wearable

technology that draws consumers' attention—and spending power—away from the smartphones that have hypnotised them for the past decade and a half. With smart watches, smart earphones and, soon, smart spectacles, the phone could become personal computing's back office rather than its primary interface. Gadgets on your eyes would complement the “things on our wrists, things on our ears and things in our pockets”, thinks Mr Shmulik. One day, he speculates, “you might even forget that you've got your phone.” ■



眼见为实

从苹果到谷歌，科技巨头都在打造VR和AR头显

它们可能是智能手机之后的下一个大平台

九岁的拉尔夫·迈尔斯（Ralph Miles）慢慢摘下Quest 2头显，眼睛瞪得像铜铃一样。“简直就像在另一个星系！”他大喊。刚过去的十分钟里，他安静地坐在伦敦一家百货商店的家用电子产品区里，但同时却在用震耳欲聋的激光炮轰炸外星机器人。销售人员在旁边忙个不停，撺掇他把这套东西带回家。“买回去就太好了！”拉尔夫激动不已。“别撩拨他了。”他的父亲警告说。

对“扩展现实”（extended reality）感到兴奋的不再只有儿童。“扩展现实”包括完全沉浸式的虚拟现实（VR）和将计算机图像叠加到用户所看到的实际景象上的增强现实（AR）。几乎每家大型科技公司都在抓紧开发VR或AR头显，它们坚信这一长期都偏小众的市场可能正处在爆发边缘。

Facebook的母公司Meta在过去18个月内售出了大约1000万台Quest 2头显，更先进的Cambria将于今年上市。微软正在向企业推销其价格更高的HoloLens 2。预计苹果将于2023年初推出首款头显，据说下一代型号也已在酝酿中。谷歌正在开发名为Iris的头显。从字节跳动到索尼和Snap，许多二线科技公司也都在销售或开发自己的产品。

科技巨头发现了两个潜在的巨大市场。一是设备本身。数据公司IDC预测，今年头显的出货量将只有约1600万台（见图表）。但IDC的杰特什·乌布拉尼（Jitesh Ubrani）认为，十年之内，在成熟市场上其销量可能会赶上智能手机。“有人问，‘你认为这个市场的规模能赶上智能手机市场吗？’”既为头显也为手机制造芯片的高通公司的雨果·斯瓦特（Hugo Swart）说。“我认为头显市场的规模会更大。”

这指向了第二个更诱人的机遇：对下一个大平台的控制。苹果和谷歌已经确立了在智能手机界里地主的地位，对它们应用商店里的每一笔交易收取

提成，并制定广告等方面的规则，牺牲了Facebook等数字租户的利益。谁垄断了头显市场，谁就将获得同样强大的守门人地位。“这将是下一场科技盛宴，”乌布拉尼说，“大家都想确保自己能分到一杯羹。”

随着上一个平台显露出成熟的迹象，人们开始寻找下一个平台。根据IDC的数据，美国的智能手机出货量从2017年最高峰的1.76亿部下降到2021年的1.53亿部。推动了Facebook和谷歌等公司发展的广告模式正受到隐私权倡导人士的攻击。为应对这种局面，Meta的老板扎克伯格将公司的未来押在了“元宇宙”上。微软CEO萨蒂亚·纳德拉（Satya Nadella）曾表示，扩展现实将成为塑造未来的三种技术之一（另外两个是人工智能和量子计算）。谷歌母公司Alphabet的CEO桑达尔·皮查伊（Sundar Pichai）去年表示，AR将成为“我们重要的投资领域”。据数据公司Crunchbase称，风投基金在2021年最后一个季度向扩展现实技术注入了近20亿美元，创历史新高。

现在售出的头显中约有90%是VR。自2014年以20亿美元收购头显制造商Oculus以来，Meta占领了这一市场，2021年占VR设备销量的80%。Quest 2无需计算机配合，体验逼真（尽管也稍微有点让人晕眩）。得益于疫情封锁和299美元的超低价，它在2020年一经推出即成爆款。去年圣诞节，Quest应用成为美国下载次数最多的智能手机应用。制造VR游戏装备的较小竞争对手正在受到挤压，如台湾电子公司HTC和美国游戏开发商Valve等。Pico是TikTok中国母公司字节跳动旗下的头显制造商，在Meta被禁的中国本土市场表现良好。

Meta的VR策略仍然围绕广告展开。分析公司Omdia的乔治·吉贾什维利（George Jijashvili）表示，Meta正在尽快销售设备，以求为广告主吸引受众。Horizon Worlds和Horizon Venues是Meta的虚拟社交空间，号称每月有30万名用户。令一些用户恼火的是，Meta已经开始尝试在里面投放广告。Cambria是一种更贵的“透视”头显，除了有类似VR的屏幕，还配有前置摄像头来显示周围环境，以及对准用户面部的摄像头。这样就能捕捉用户面部表情用于虚拟形象，同时也能监控哪些广告能够吸引眼球。

Meta也在通过其应用商店获利。Omdia估计，从明年开始，VR内容的市场规模将超过VR硬件。扎克伯格推动这一新平台的动机之一是让Meta不再依赖手机制造商来分发自己的应用。该公司自身已成为一个数字地主，可以对Quest商店的每一笔交易抽成（Meta拒绝透露抽成比例），就像苹果和谷歌在智能手机应用销售中所做的一样。

Meta在VR领域高歌猛进的同时，其他公司正在尝试更复杂的AR技术。Snap的老板伊万·斯皮格（Evan Spiegel）说，与将你带到另一个世界的VR不同，AR“锚定在你周遭的世界中”。他的社交媒体应用Snapchat早就在为手机提供AR滤镜，让用户可以将自己变成卡通形象，或者借助手机摄像头来虚拟试穿衣服、试用化妆品等产品。Snap现在正在试水硬件，打造了一款AR眼镜原型，并已提供给数百名软件开发者。

笔者试用了Snap眼镜，漫游穿越一个漂浮的太阳系，然后在Snap伦敦办公室的周围被一些全息僵尸追逐。这幅眼镜重134克，外形和感觉就像一副厚实的太阳镜。造型如此纤细的缺点是电池续航时间只有30分钟，并且容易过热。受光学技术的限制，视野局限在镜片中间的一个正方形内，结果就好像是透过信箱来看叠加的图形。斯皮格说，Snap打造这一设备的主要目的是发现AR头显广泛运用时可以有哪些应用案例。在硬件市场，“我们会做一些尝试，但我们的目标仍然是AR平台本身”。

目前，AR眼镜仍是小众中的小众。高成本和不稳定的表现限制了它们的吸引力。IDC预计今年该行业的出货量将为140万台。2021年最畅销的产品是微软的HoloLens 2，售价3500美元，它的大客户包括美国军方（其10万副HoloLens 2的订单引发了微软员工的抱怨，说他们“可没有签约开发武器”）。佛罗里达州的创业公司Magic Leap将于9月推出它视野更广的第二代AR眼镜。它瞄准企业用户，如医疗保健和制造业，而不是消费者。

尽管VR在头显领域占据主导地位，但AR在大规模应用方面激起了更令人兴奋的火花。即使Meta不懈地推广虚拟音乐会、办公室会议等场景，仍然很少有人在游戏之外使用VR。根据Omdia的数据，去年在VR内容上的20亿美元支出中，90%都花在了游戏上。苹果老板蒂姆·库克批评VR有

“孤立”用户的倾向。“VR显然有一些很酷的小众应用，但在我看来没有什么深刻影响，”库克说，“而AR则意义深远。”对于让扎克伯格兴奋不已的沉浸式元宇宙，苹果并没表现出多少兴趣。

苹果将要推出的透视头显将让用户能体验一把AR。一副真正的AR眼镜仍处于早期开发阶段。据说这第一批产品的目标用户是设计师和其他创意专业人士，就像它的高端Macintosh电脑一样。尽管如此，苹果进入该行业仍可能是一个分水岭。“苹果推动产品普及的能力在市场上可能无与伦比。”经纪公司盛博的马克·施穆里克（Mark Shmulik）说。苹果将希望能在中国生意兴隆，取得它对Meta的优势。IDC预测，到2026年，AR眼镜的全球出货量可能达到2000万副，约是今天VR头显出货量的两倍。

| 有争议的现实

一大问题是，头显能否不止于满足游戏玩家和专业人士的需求，成为真正的科技平台，而不仅仅是一个配件。如今的AR和VR设备很善于解决“非常具体的痛点”，曾参与开发iPhone的前苹果高管托尼·法德尔（Tony Fadell）说。但iPhone这样的通用平台“可就完全是另一回事了”，他说。“而且我对它们没信心”，他补充道，至少在接下来的五年里是这样。法德尔认为，在可预见的未来，头显将有点像智能手表，会很流行，但没有智能手机那样的革命性影响。

斯皮格也认为头显不会完全取代手机，就像手机并没有干掉台式电脑一样。但他指出，“一种主流叙事是计算已经变得个人化得多”。它已经从大型主机转移到桌面，又转移到手掌上。他认为，下一步是通过AR将计算“叠加到你身边的世界”。桌面计算主要是做信息处理，智能手机主要是为了沟通。他认为，下一个计算时代将是“体验式的”。

在这种场景下，头显可能成为更广泛的可穿戴技术生态系统的一部分，将能够把消费者的注意力和消费能力从过去15年里令他们着迷的智能手机上转移开。有了智能手表、智能耳机和即将出现的智能眼镜，手机可能会成为个人计算的后台，而不是主要界面。施穆里克认为，戴在眼睛上的东西将与“戴在我们手腕上、耳朵上和装在口袋里的东西”互补。他推测说，

某一天，“你甚至可能会忘记自己还有部手机”。■



The Economist Film

NFTs - Are they worth the hype? Part 2

NFTs are moving beyond the world of art and into the metaverse. But NFTs also has more serious uses.



经济学人视频

NFT热潮是泡沫吗？（下）

NFT正在从艺术世界进入元宇宙。但它们还有更严肃的应用场景。



Personalised medicine

Genetic screening can improve drug prescribing

Most people carry at least one mutation that can stop a drug working properly

PETER LEY, a retired civil servant who lives in London, was diagnosed with colon cancer in 2017. An operation to remove the tumour was successful. But the chemotherapy that followed caused a severe reaction that required a two-week hospital stay and a pause in his cancer treatment.

All that could have been avoided had a simple test been done. The test examines a gene that encodes a liver enzyme called dihydropyrimidine dehydrogenase (or DPD for short). The enzyme breaks down several common cancer drugs. Without it, toxic levels of the drugs build up in the body, sometimes with fatal results. A complete inability to make DPD is rare, but there are four mutations in the DPD-regulating gene that are known to reduce its production. As it turned out, Mr Ley had one of them.

Screening for such “pharmacogenes” is an idea that is catching on among doctors. Several big hospitals in America are testing their patients for a dozen or more of them. Separate pilot projects are under way in at least seven of the European Union’s member states. Britain’s National Health Service (NHS) is doing screening tests for some patients being prescribed cancer and HIV drugs. A report on March 29th by the British Pharmacological Society (BPS) and the Royal College of Physicians (RCP) proposed widening that testing to cover the 40 drugs among the 100 most-prescribed that are known to be affected by pharmacogenes. The report’s authors reckon testing could feasibly be rolled out across the NHS as soon as 2023.

Genetic screening promises big benefits. Mutations can affect drugs in all sorts of ways, determining a pill’s efficacy, toxicity, how well it is absorbed,

and how well it is broken down. Some genetic variants affect several drugs at once, because they alter common enzymes in widely used metabolic pathways. Britain's 100,000 Genomes project has shown that almost 99% of people carry at least one pharmacogene; 25% have four. About 9% of Caucasian people have, like Mr Ley, DPD deficiency; one in 200 lack the enzyme completely. Roughly 8% of Britain's population get little pain relief from codeine, because they lack an enzyme responsible for metabolising the drug into morphine (they instead metabolise it into other substances that have little influence on pain).

All told, scientists have identified about 120 such drug-gene pairs so far. Roughly half of them are "actionable", says Henk-Jan Guchelaar, a pharmacologist at the University of Leiden in the Netherlands—meaning that changing the dose or replacing the drug can lead to a better clinical outcome. And most people will be prescribed at least one of those drugs at some point in their lives. In Britain people over the age of 70 have around 70% chance of taking at least one drug whose safety or efficacy is compromised by their genes, says Munir Pirmohamed, a pharmacologist and geneticist at the University of Liverpool.

Currently, clashes between a patient's genome and his drug regimen are dealt with by trial-and-error prescribing. But that is time-consuming, and may be harmful. If a drug is being prescribed for high blood pressure or artery-clogging levels of cholesterol, time spent trying different drugs means time in which a stroke, heart attack or organ damage may occur. And cleverer prescribing would have benefits for the health-care system overall, as well as for individual patients. Adverse drug reactions account for 6.5% of hospital admissions in Britain.

The chief issue, as ever, is cost. In the Netherlands a test for 50 pharmacogenes costs about €200 (\$217). In Britain a panel test for 40 such genes costs £100-150 (\$130-195). Carrying out testing on an entire

population would, therefore, be extremely expensive. Some light on whether it is worth the cost will be shone later this year when PREPARE, a study that began in 2017, publishes its results. The project, which is led by Dr Guchelaar, recruited 7,000 people across seven European countries for a study of mutations affecting 42 different drugs. Half the participants were screened, and given cards listing the drugs flagged up. That information, in turn, was made available to doctors, pharmacists and the like. Dr Guchelaar and his colleagues are analysing how much this reduces adverse drug reactions compared with the unscreened participants—and, crucially, the health-care costs averted as a result.

Such cost-benefit analyses will be vital in making the argument that governments or insurance firms should pay for widespread genetic testing. In the meantime, though, doctors are already pondering ways to get the most bang for their buck. The BPS and RCP study suggests several ways to expand pharmacogene screening. One is to test for the genes the first time a drug known to be susceptible is prescribed. Another option is to offer that test to everyone over a certain age, perhaps 50—though the NHS is also pondering the idea of comprehensive genetic screening for all newborn babies. That could pay off handsomely later in their lives. ■



个性化用药

基因筛查可以改善用药方案

大多数人携带至少一种会影响药物疗效的突变【新知】

彼得·利（Peter Ley）是住在伦敦的一名退休公务员，在2017年被诊断患有结肠癌。他的肿瘤切除手术很成功。但之后的化疗产生了严重的不良反应，他需要住院两周，并暂停了癌症治疗。

这一切本可以避免——只要做个简单的检测。检测的对象是一种叫作二氢嘧啶脱氢酶（简称DPD）的肝酶的编码基因。DPD能分解好几种常用的抗癌药物。如果缺乏DPD，药物的毒性会在人体内蓄积，甚至可能致人死亡。完全不能生成DPD的情况很少见，但已知有四种DPD调控基因的突变会减少DPD生成。结果，利就有其中一种。

筛查这类“药物基因”的想法开始在医生中流行起来。美国的几家大医院正在对患者进行十多种或更多的药物基因检测。至少有七个欧盟成员国也在开展各自的试点检测项目。英国国家医疗服务体系（NHS）正在对一些使用癌症和艾滋病药物的患者做筛查。英国药理学会（BPS）和皇家医师学院（RCP）在3月29日发表的一份报告中提议扩大这项筛查，覆盖已知受到药物基因影响的100种最常用处方药中的40种。报告作者预计，这种检测最早可能在2023年在NHS系统中全面推广。

基因筛查可能带来巨大的益处。突变可能以各种方式影响药物，决定一种药的效力、毒性、吸收程度和分解情况。一些基因变异会同时影响几种药物，因为它们改变了广泛使用的代谢路径中常见的酶。英国的“十万人基因组计划”表明，几乎99%的人携带至少一种药物基因；25%的人携带四种。大约9%像利这样的白种人患有DPD缺乏症；每200人中有一人完全没有DPD。大约8%的英国人无法用可待因镇痛，因为他们缺乏一种将可待因代谢成吗啡的酶，而是把它代谢成了其他对疼痛无甚影响的物质。

迄今为止，科学家总共确定了大约120个这样的药物基因对。荷兰的莱顿

大学（University of Leiden）的药理学家亨克让·居什拉尔（Henk-Jan Guchelaar）表示，其中大约一半的药物基因对具有“可操作性”，也就是说，改变剂量或更换药物可以获得更好的临床效果。而且，大多数人在一生中的某个阶段都会服用其中一种药物。利物浦大学的药理学家和遗传学家穆尼尔·皮尔穆罕默德（Munir Pirmohamed）表示，英国70岁以上人口约有70%的几率使用至少一种安全性或有效性被自身基因折损的药物。

要解决患者的基因组和用药方案之间的冲突，目前使用的是试错式用药法。但这种方法周期长，还可能造成伤害。如果是为高血压或胆固醇升高引发的动脉阻塞开药，在花时间尝试各种不同药物的过程中，中风、心脏病或器官损伤都可能发生。而且，精准的用药方案不仅是对病人个体的福音，对整个医疗系统也有好处。在英国，因药物不良反应住院的人数占到总住院人数的6.5%。

费用依然是主要问题。在荷兰，对50种药物基因做一次检测的费用约为200欧元（217美元）。在英国，对40种药物基因做一次组合检测要花费100至150英镑（130至195美元）。由此可见，实施全民药物基因检测的成本极高。今年晚些时候，一项始于2017年的研究项目“PREPARE”将公布结果，届时这笔钱是否值得花的问题会有更清晰的答案。这个由居什拉尔主持的项目在七个欧洲国家招募了7000人，研究会影响42种不同药物疗效的基因突变。半数参与者接受了筛查，并拿到了慎用药物清单。这些信息而后提供给了医生和药剂师等相关人员。居什拉尔和同事们正在分析，与未接受筛查的参与者相比，这种做法在多大程度上减少了药物不良反应，以及避免了多少由此产生的医疗成本——这一点至关重要。

这样的成本效益分析对于论证政府或保险公司是否应该为广泛的药物基因检测买单将是不可或缺的。不过，与此同时，医生们已经在考虑如何让效益最大化。BPS和RCP的研究提出了几种推广药物基因筛查的方法。一是针对某种已知易受影响的药物，在首次开处方时对患者做药物基因检测。另一种是把药物基因检测的对象设定为超过一定年龄的人群，比如50岁——但NHS也在考虑对所有新生儿做全面的基因检测。那可能会让他们日后的生活受益匪浅。■



Bartleby

How to make hybrid work a success

Clarity of expectations is the key

WHITE-COLLAR WORKERS tend to like hybrid working. Research by Nicholas Bloom of Stanford University suggests that, on average, employees reckon the blend of in-person and remote work is a perk equivalent to an 8% pay increase. The biggest attraction of days spent working from home is the absence of a commute. Other benefits include not having to get ready for the office: the proportion of people wearing a fresh set of clothes drops by 20 percentage points when they are not commuting.

Executives have been keener to get people back into the office full-time, so that employees can bond with peers, absorb the corporate culture and appreciate the awesome power of laundry. But even sceptics have accepted that hybrid working will be part of the post-pandemic future: in his annual letter to shareholders early this month, Jamie Dimon, the boss of JPMorgan Chase, said he thought that about 40% of the bank's staff would be hybrid. The job now is to make sure that hybridisation works as well as it can for both employees and employers. That depends on one ingredient above all: clarity. Things function best when everyone knows what is expected.

Start with the shape of the hybrid week. One of the great theoretical attractions of hybrid working to employees is that they get to choose what days they come in. But the point of in-person working is to spend time collaborating and bonding with their colleagues: that is much more likely to happen if companies are clear about who they want in the office on which days of the week.

Clarity also maximises the benefits of work-from-home days. If office time

is best spent in a whirlwind of collaborative brainstorming and socialising, home days are logically the time when solo and focused work should get done. That requires bosses to do what comes unnaturally to them, by resisting the temptation to interrupt at will.

It is easier to do that if expectations are clear. Anne Raimondi of Asana, a work-management platform, says the firm expects people to come in on Mondays, Tuesdays and Thursdays, and has a “no meetings” day on Wednesday. If a manager wants to have a meeting that day, they have to “recontract” with their team and explain why it is needed.

By the same token, being explicit when a reply is needed on an email saves everyone scurrying around in a desperate bid to answer the boss first. Defining what kinds of work can be done asynchronously and what requires everyone to get together is a recipe for fewer, better meetings. Encouraging a set of do-not-disturb protocols makes it less likely that employees will be bothered unnecessarily.

Clear protocols also make hybrid meetings go better. Harry's, a shaving firm that has published its guidelines for hybrid working, expects each attendee to have their own screen and promises not to keep discussing the matter at hand once remote colleagues have left the meeting (though commenting on who is wearing the same clothes as they did yesterday is presumably fine).

Some of this will be deeply alarming to managers who worry about slippery slopes. First you give people space to focus at home, and soon enough you cannot contact anyone because they have changed their settings on Slack and are binge-watching “Bridgerton”.

There are three answers to such worries. First, expectations are firmly in the gift of managers. Asana's no-meetings day does not extend to meetings

with customers, for example.

Second, burnout is as much of a risk as slacking. New research from Microsoft finds evidence for what it calls a “triple-peak day”. As well as the usual large crests in activity in the early morning and after lunch, around 30% of employees at the tech giant also experience a smaller, third bump in work in the late evening. That may be a sign of people getting work done when it suits them—or of the workday extending relentlessly into every waking hour. Setting expectations, over things like how quickly notifications need to get a response, can help determine which one it is.

Last, good performance is not defined by employees’ locations at specific times of the day but by what they achieve—what Mr Bloom calls “managing outputs, not inputs”. If bosses can articulate what counts as productive activity, and evaluate it regularly, it matters less whether employees are at headquarters or stinking out the spare bedroom. Managers may have concerns about hybrid working, but it is pretty clear what will make it successful. ■



巴托比

如何让混合式工作卓有成效

要求明确是关键

白领往往喜欢混合办公模式。斯坦福大学的尼古拉斯·布鲁姆（Nicholas Bloom）的研究表明，平均而言，员工认为现场和远程办公相结合是一种相当于加薪8%的福利。居家办公最大的吸引力是无需通勤。其他好处还包括不必为去办公室做准备：不用通勤时，每天都换装的人的比例下降了20个百分点。

领导们则一直更想让员工每天都回到办公室工作，好让他们能增进彼此间的关系，汲取企业文化，并体验穿戴整洁带来的神奇力量。但即使是原本持怀疑态度的人也开始认识到混合式工作将成为后疫情未来的一部分。本月初，摩根大通老板杰米·戴蒙（Jamie Dimon）在年度致股东信中表示，他认为自己公司大约40%的员工将采用混合式工作。现在的任务是确保混合式工作对雇佣双方都能起到最佳效果。这关键取决于一个因素：明确。当每个人都知道给自己的任务和要求是什么的时候，效果才最好。

先从混合式工作周的架构说起。理论上讲，混合式工作对员工的一大吸引力是他们可以自行选择在每周的哪几天去办公室。而现场工作的意义在于能和同事协作并增进关系。如果公司明确在一周的哪几天安排谁来办公室，实现这种好处的可能性就会大增。

明确性还能充分实现居家办公的好处。如果说办公室上班最适合进行旋风式的团队头脑风暴和社交活动，那居家工作显然最适合用来做那些可独立完成或者需要集中注意力的工作。这就要求老板们勉为其难地克制一下自己，不要随意打扰员工。

如果预期非常明确，做到这一点就没那么难。工作管理平台Asana的安妮·雷蒙迪（Anne Raimondi）表示，Asana希望员工周一、周二和周四去办公室，并且周三“不开会”。如果哪个主管想在周三开会，就必须与自己

的团队“重新协定”，并解释这么做的必要性。

同理，如果是电子邮件，那就明确需要的回复时间，这样就不用每个人都急着抢先回复老板的邮件了。明确哪些工作可以非同步完成，哪些需要所有人集结参与，可以有效减少会议次数、提高会议质量。鼓励制定一套“勿扰”规范，就可能减少对员工不必要的打扰。

明确的规范也让混合式会议更顺畅高效。剃须用品公司Harry's已经发布了自己的混合式工作指南，要求每位与会者都出现在屏幕上，同时承诺一旦远程与会的同事下线，便不再继续讨论手头的工作（不过或许还是可以对谁穿的衣服和昨天一样评头论足一番）。

其中一些变化可能会让那些担心“滑坡效应”的管理者忧心忡忡。一开始，你给员工空间，让他们在家能专心工作，但很快却发现一个人联系不上了，因为他们更改了在Slack平台上的设置，正在刷《布里奇顿》（Bridgerton）这部剧呢。

对于这样的担忧，有三个解决办法。首先，关于员工该做什么，管理者有绝对的解释权。例如，Asana的“不开会日”并不包括与客户的会议。

其次，发生过度劳累的可能性并不比偷懒怠惰低。微软的一项新研究证实了它所说的“一日三高峰”。除了通常在清晨和午餐后出现的两次较大的工作高峰时间外，这家科技巨头大约30%的员工还会在深夜经历第三个较小的工作高峰。这可能是因为员工选择在自己喜欢的的时间完成工作，也可能是因为工作时间过度延长，只要醒着就在工作。对事情制定要求，比如发出通知后需要多快得到反馈，可以帮助弄清是哪种原因。

最后，评价员工的工作表现并不是看他们一天中某个时间在哪里工作，而是看他们工作的完成情况——也就是布鲁姆所说的“管理产出，而非投入”。如果老板能清楚地说明什么算富成效的工作，并定期做评估，那么员工的工作地点——是在总部办公室，还是在被他们自己弄得臭烘烘的备用卧室——就不那么重要了。尽管管理者可能对混合式工作有着这样或那样的担忧，但怎么做能让它卓有成效却是显而易见、清楚不过的。■



Frames of mind

The first reference charts for the human brain have been completed

They could become a useful tool in tracking healthy (and unhealthy) ageing

IF A DOCTOR wants to know how well a child is growing, she can turn to clinically validated charts that lay out precisely how that child compares to the norm for their age and sex. Not only can the doctor look up, say, how many centimetres shorter or taller the child is than the average for their age, but exactly what height percentile they fall into. Medical diagnoses can then be made based on an absolute comparison with the statistical norm.

Reference charts are an important tool in modern primary medicine, covering many aspects of a person's healthy development. There is, however, a big gap in their coverage: the human brain. Richard Bethlehem and Simon White from the University of Cambridge and Jakob Seidlitz from the University of Pennsylvania want to fix that. Writing in *Nature*, the neuroscientists describe the most comprehensive effort yet to create a standard against which someone's brain development can be measured through their lifetime.

Their brain charts were compiled from more than 120,000 three-dimensional brain scans belonging to more than 100,000 patients who took part in more than 100 different research studies. The data set included people of all ages, ranging from babies still developing in the womb, just over 100 days after conception, to adults more than 100 years old.

With that data, the scientists catalogued how the average human brain evolved from cradle to grave, focusing on three types of brain tissue: grey matter (made up of neuron cell bodies), white matter (the filaments connecting neurons) and tissue conveying cerebrospinal fluid (the brain's plumbing system). The scientists paid particular attention to the cerebral

cortex, the outermost layer of the brain, responsible for higher-order brain functions. They observed grey matter in the cortex peaking in volume at 5.9 years, 2 to 3 years later than previously thought.

Having characterised the development and ageing of the average human brain, the scientists modelled the distribution around it, charting the percentile-by-percentile variation in the structure of human brain tissue. This allowed them to investigate how the brains of patients with various developmental or degenerative disorders compare to more typical brains. “Our investigation confirmed that Alzheimer’s disease, mild cognitive impairment and schizophrenia show marked restructuring of brain tissue relative to a more typical brain of the same age and sex,” says Dr Seidlitz.

The catalogue turned up some surprises too. Autism, for example, is generally thought to present differently in male and female patients, but there is little sign of that difference in their brain tissue. In contrast, attention deficit hyperactivity disorder (ADHD)—which presents similarly by sex—displays the largest average difference in brain structure between male and female patients of any diagnosis they analysed. Over the course of a lifetime, the brains of male ADHD patients appear to be skewed towards below-average volumes of grey matter, white matter and cerebrospinal fluid. The brains of female ADHD patients, on the other hand, were ever-so-slightly skewed towards higher volumes of the same tissues.

What these differences in brain size mean is not yet clear. And the authors caution that their brain charts are not yet ready for clinical use, not least because the dataset they used has several limitations. “Unfortunately, the data we compiled reflect the demographic biases of neuroscience research in general, ie, most studies are from Europe or North America, and over-represent patients of European ancestry,” says Dr Bethlehem.

To reflect the full diversity of normative human brain development, a more

representative dataset will be required. Once that is accomplished, the utility of brain charts can begin to be tested in a clinical setting. One day, hopefully, these charts could become a useful tool in tracking a person's brain health or spotting the earliest physical signs of brain disorders such as Alzheimer's disease. ■



脑框架

首组人脑参照表出炉

它们可能会成为跟踪健康（以及不健康）衰老的有用工具【新知】

如果医生想知道一个孩子生长发育得如何，她可以查看经临床验证的图表，上面精确列出了这个孩子与同年龄同性别的孩子的标准值相比的状况。比如，医生不仅可以看到这个孩子比同龄人的平均身高矮或高多少厘米，还可以看到孩子所处的确切的身高百分位数。在与统计标准值做绝对比较之后，就可以做出医学诊断。

参照表是现代基础医学的重要工具，涵盖了个人健康发展的方方面面。但其中留有一个很大的空白：人脑。剑桥大学的理查德·伯利恒（Richard Bethlehem）和西蒙·怀特（Simon White）以及宾夕法尼亚大学的雅克布·赛德利茨（Jakob Seidlitz）想要填补这个空白。这几位神经学家在《自然》杂志上撰文，介绍了在创建能衡量一个人一生中脑部变化的标准上迄今最全面的努力。

他们的脑参照表根据超过12万张三维脑扫描图编制而成，这些扫描图来自10万多名参与了100多项不同研究的患者。这一数据集涵盖了各个年龄段的人——从受孕才100多天仍在子宫里发育的胎儿到100多岁的老人。

有了这些数据，几位科学家将一般人脑从摇篮到坟墓的发展过程编目分类，重点关注三种脑组织：灰质（由神经元细胞体组成）、白质（连接神经元的纤维）和输送脑脊液的组织（大脑的管道系统）。他们特别关注大脑皮层，这是大脑的最外层，负责更高级的脑功能。他们观察到大脑皮层中的灰质体积在5.9岁时达到峰值，比之前认为的晚2到3年。

确定了人脑的一般发育和老化特征之后，科学家们围绕它建立了分布模型，绘制出了人脑组织结构百分位数的变化图。这让他们能够研究患有各种发育性或退行性疾病的患者脑部与更健康的脑部有何不同。“我们的研究证实，与同年龄同性别的一般脑部相比，阿尔茨海默病、轻度认知障碍

和精神分裂症患者表现出明显的脑组织重组。”赛德利茨说。

这项分类整理还有一些令人惊讶的发现。例如，通常认为自闭症在男性和女性患者身上的症状表现不同，但在他们的脑组织中却几乎看不到差异。与之相反的是，注意缺陷多动障碍（ADHD）在不同性别的患者身上的症状表现差不多，却在脑结构上呈现出所有被分析的病症中最大的男女平均差异。男性ADHD患者的脑灰质、白质和脑脊液的体积终其一生往往低于平均水平，而女性患者的这些脑组织的体积却往往略微高于平均。

脑组织大小上的这些差异有何意义目前还不清楚。作者也提醒说，他们的脑参照表还不能用于临床，主要是因为他们使用的数据集存在某些局限性。“很遗憾，我们汇编的数据反映出神经科学研究在总体上存在的人口特征偏差，因为大多数研究是在欧洲或北美做的，欧洲血统的病人占比过大。”伯利恒说。

要反映人脑正常发育的多样性，将需要一个更具代表性的数据集。一旦完成，脑参照表的效用就可以开始在临床环境中被检验。有朝一日，这些图表可能有望成为一种有用的工具，能够追踪一个人大脑的健康状况，或是一早发现像阿尔茨海默病这样的脑部疾病的苗头。■



The glymphatic system and dementia

Alzheimer's researchers are studying the brain's plumbing

Tweaking it may delay development of the disease

IN MOST BODILY organs waste matter is cleared out by the lymphatic system. Unnecessary proteins, superfluous fluids and so on are carried away by special vessels to lymph nodes, where they are filtered out and destroyed. The more active the organ, the more of these vessels there are. The exception is the brain, which has none. It was thus thought until recently that brain cells broke down nearby waste products in situ.

But a paper published in 2012 reported that the brain has a plumbing system of its own to flush out the junk. Researchers working in the laboratory of Maiken Nedergaard, at University of Rochester, in New York state, showed that cerebrospinal fluid—the liquid which suspends the brain and acts as a cushion between it and the skull—was actively washing through the organ by hitchhiking on the pulsing of arteries and veins that happens with every heartbeat. The fluid was collecting trash and carrying it out of the brain to lymph nodes for disposal. Now, ten years later, the discovery of this “glymphatic” system, so called because of the involvement of brain cells known as glia, has opened up new opportunities for the treatment of brain disorders.

| *Brainwashing*

From the first studies of the glymphatic system, it was clear it might be involved in preventing Alzheimer's disease. Alzheimer's is caused by a build-up of two types of proteins, amyloid-beta and tau. These aggregate to form plaques and tangles that stop neurons working properly and eventually lead to their death. When it is functioning normally, the glymphatic system clears out amyloid-beta and tau. However, in older

people, or those with Alzheimer's, this process is slower—leaving more potentially harmful proteins behind.

Giving the brain a power wash, by improving the flow of glymphatic fluid, is a potential avenue for treatment. Though the field is in its infancy, most attempts to do so have focused on an interesting quirk of the system. This is that glymphatic fluid moves through the brain only during sleep. The plumbing is disabled during waking hours, and is most active during the deepest sleep stages, switched on by slow-wave brain activity.

That discovery has changed how researchers think about the role of sleep, and also about the link between sleep and neurological disorders. For many diseases, including Alzheimer's, a lack of sleep earlier in life increases the risk. Dr Nedergaard thinks that inadequate glymphatic clearance is the reason. Even a single night of sleep deprivation can increase the amount of amyloid-beta in the brain.

Many drugs affect sleep, sometimes as a side-effect of their main purpose. A study published in *Brain* earlier this year followed almost 70,000 Danes who were being treated for high blood pressure, using beta-blockers. Some, but not all, types of beta-blockers are able to enter the brain by passing through the blood-brain barrier. This is a system of tight junctions between cells lining blood vessels in the brain, which exists to stop the admission of molecules that might upset the function of the organ. Once there, these beta blockers affect normal patterns of sleep and wakefulness. That, in turn, promotes glymphatic circulation. Those in the study who took barrier-crossing beta-blockers every day were less likely to develop Alzheimer's than people taking beta-blockers which could not enter the brain.

Another medicine, suvorexant, which is used to treat insomnia, also shows promise. In one recent study, mice with a mutation that causes early-onset

Alzheimer's in people, and similar symptoms in rodents, were given this drug. Mutated mice receiving suvorexant experienced less build up of amyloid-beta. Even more remarkably, the drug also reversed their cognitive decline. In a maze test, mutated mice on suvorexant performed as well as healthy, unmutated ones. A preliminary human trial of this effect is now under way.

Sleep-promoting drugs can, however, have bad side-effects. Indeed, in many cases, including the Danish study, they increase the risk of death from other causes. Other people are therefore trying to boost glymphatic clearance by different means.

One project, examining mice genetically engineered to be prone to Alzheimer's, found that increasing slow-waves during sleep, thus boosting fluid flow through the brain, reduced the amount of amyloid build up. This work involved "optogenetics", in which cells are genetically engineered to respond to light, which is obviously a non-starter for a treatment for people. But a similar effect can be induced harmlessly in humans by non-invasive electrical stimulation.

| *Call the plumber*

Some studies report that such stimulation can improve memory formation in the elderly. And it may also be relevant to the young and fit. America's Department of Defence is paying for at least two projects which have the goal of developing wearable caps to improve glymphatic flow during sleep in this way. Lack of sleep is a big problem in the armed forces. During combat, getting a solid eight hours can be hard, and lack of sleep inevitably affects a soldier's performance.

As well as emphasising the importance of a good night's sleep, the discovery of the glymphatic system has highlighted other ways that a healthy life can promote a clean and tidy brain. In mice, exercise improves

glymphatic flow, flushing out amyloid-beta. By contrast, high blood pressure, which prevents the normal pulsing of arteries and veins that drives the system, reduces fluid movement. In this context it is no surprise that hypertension during middle age increases the risk of developing Alzheimer's disease later on in life.

The glymphatic system's discovery has had effects outside Alzheimer's research, too. Traumatic head injury, Parkinson's disease and mood disorders are all linked to glymphatic clearance. There is hope, as well, that this newly found plumbing may help with the delivery of brain drugs. Getting medicines past the blood-brain barrier is notoriously difficult. Injecting them into the cerebrospinal fluid directly, then allowing them to wash throughout the brain during sleep, may be simpler.

Decades of Alzheimer's research has left behind a graveyard of failed drug trials. The brain's plumbing network is providing new targets, and new ways to think about treatments for the disease. The glymphatic system, then, is at last being tapped. ■



胶状淋巴系统与痴呆症

阿尔茨海默病研究人员探索大脑管道

微调这个系统也许能延缓病情发展【新知】

在大多数身体器官中，废物是由淋巴系统清除的。不必要的蛋白质、多余的液体，诸如此类的物质经专门的血管输送到淋巴结，在那里被过滤出来并清除。器官越活跃，里面的此类血管就越多。人脑却是个例外，它没有这样的血管。所以，直至近年，人们一直都以为脑细胞是就地分解所产生的废物的。

但2012年发表的一篇论文指出，人脑有自己专门的管道系统来冲走这些废物。位于纽约州的罗切斯特大学（University of Rochester）由麦肯·尼德加德（Maiken Nedergaard）负责的实验室发现，脑脊液（让脑在颅骨内悬浮并在脑和颅骨之间起缓冲作用的液体）会利用心跳时动脉和静脉的脉动主动冲洗整个脑部。脑脊液收集脑内废物，将之带离大脑并送至淋巴结清除掉。十年后的今天，有关这种“胶状淋巴”系统（因涉及名为神经胶质细胞的脑细胞而得名）的研究为治疗脑部疾病创造了新的机会。

| 洗脑

对胶状淋巴系统的早期研究就显示出，它可能帮助阻止了阿尔茨海默病的发生。该病的成因是 β 淀粉样蛋白和tau蛋白这两类蛋白质积聚，形成斑块和缠结，阻碍神经元正常工作，最终致其死亡。胶状淋巴系统正常运作时能把 β 淀粉样蛋白和tau蛋白清除掉。然而，对于老年人或阿尔茨海默病患者，这个过程会减慢，令较多可能有害的蛋白质积聚下来。

改善脑脊液的流动，给大脑来一次强力清洗，可能是阿尔茨海默病的治疗路径之一。不过这方面的研究还处于起步阶段，相关尝试大多都针对该系统的一个有趣的古怪特性——只有当人处于睡眠状态时脑脊液才会在脑内流动。这个管道系统在人清醒时停止作业，在深度睡眠阶段最为活跃，由慢波脑活动启动。

这一发现改变了研究人员对于睡眠的作用以及睡眠与神经系统疾病之间联系的看法。年轻时睡眠不足会增加日后罹患阿尔茨海默病等许多疾病的风险。尼德加德认为，脑脊液清废能力不足是原因所在。即使只是一个晚上不睡觉，也可能令大脑中 β 淀粉样蛋白的数量上升。

许多药物会影响睡眠，有时候这是药物的副作用。今年早前发表在医学期刊《脑》（Brain）上的一项研究追踪了近七万名使用 β 受体阻断剂治疗高血压的丹麦人。一些类型（非全部）的 β 受体阻断剂能穿越血脑屏障进入大脑。血脑屏障是大脑血管内壁的细胞相互紧密连接形成的屏障系统，阻止可能破坏大脑功能的分子进入。 β 受体阻断剂一旦突破这一屏障，就会影响常态睡眠和觉醒模式。这反过来又会促进脑脊液循环。在这项研究中，相比服用不能进入大脑的 β 受体阻断剂的受试者，每天服用能跨越血脑屏障的 β 受体阻断剂的受试者患阿尔茨海默病的几率更低。

另一种用于治疗失眠的药物苏沃雷生（suvorexant）也显现了潜力。在近期一项研究中，出现一种基因突变（该突变会导致人罹患早发性阿尔茨海默病并能让啮齿动物出现类似症状）的小鼠被喂服苏沃雷生。服用该药物的突变小鼠脑内积聚 β 淀粉样蛋白的情况较轻。更值得注意的是，该药物还逆转了小鼠的认知衰退。在迷宫测试中，服用苏沃雷生的突变小鼠表现与没有突变的健康小鼠一样好。对该药物效果的初步人体临床试验正在进行中。

然而，助眠药物也可能有不良副作用。事实上，在许多情况下，包括上述丹麦研究，这些药物会增加因其他因素死亡的风险。因此，其他研究人员正在另寻方法来提升脑脊液的废物清除力。

有一个项目研究了经基因改造变得易患阿尔茨海默病的小鼠，发现增加它们睡眠时的慢波能促进脑脊液在脑内流动，从而减少淀粉样蛋白积聚。该过程涉及“光遗传学”操作，即通过基因改造使细胞对光产生反应，这显然不适用于治疗人类。但可以通过对人体施加非侵入性的电刺激无害地诱发类似的效果。

| 呼叫管道工

一些研究指出，这类刺激可改善老年人的记忆形成。对年轻健康人群可能也有用。美国国防部正在资助至少两个智能帽子开发项目，试图通过这种刺激来提升睡眠期间脑脊液的流动。睡眠不足是军队中的一大问题。战时要安稳地睡上八小时是件难事，而睡眠不足难免会影响士兵的表现。

除了好好睡觉的重要性，胶状淋巴系统的发现还显示出健康的生活能通过其他方式带来一颗干净清楚的大脑。在小鼠身上，运动改善了脑脊液流动，冲走了 β 淀粉样蛋白。相比之下，高血压会阻碍驱动胶状淋巴系统的动静脉正常脉动，令脑脊液的流动减慢。如此一来，中年患高血压会增加日后患阿尔茨海默病的风险也就不奇怪了。

除了阿尔茨海默病，胶状淋巴系统的发现还推动了其他疾病的研究。创伤性头部损伤、帕金森病和情绪障碍都与脑脊液的废物清除力相关。这个新发现的管道系统也有希望帮助输送脑病药物。要让药物穿透血脑屏障是出了名的难事。把药物直接注射到脑脊液中，让药物在患者睡眠时冲刷整个脑部，也许是更简单的方法。

阿尔茨海默病研究进行了几十年，留下了一大批失败的药物试验。脑部管道网络为治疗这种疾病提供了新目标和新思路。胶状淋巴系统终于打开水龙头了。■



Pervasive problems

Consumer prices in America rise at their fastest pace since 1981

How inflation is becoming more broad-based

UNHAPPY ECONOMIES are often unhappy in their own ways. Today most, however, are battling a common foe: a surge in consumer-price inflation. According to figures released on April 12th, consumer prices rose by 8.5% in March in America, compared with a year earlier—the fastest pace since 1981. In Britain and the euro area consumer prices rose by 7% and 7.5%, respectively, in the year to March. Across most rich and emerging economies, inflation is now well above central banks' targets.

In summer 2020, after a period of too-low inflation, America's Federal Reserve said that it would tolerate inflation that was a little above its 2% target for a time, in the hope of making up for undershoots. In the subsequent 20 months, consumer prices have blown past where they would have been had the Fed achieved its 2% target on average, putting pressure on the central bank to raise interest rates fast.

In many places a big chunk of current headline inflation reflects rises in energy prices, which soared after Russia's invasion of Ukraine jolted commodity markets. In March these explained about half of the euro area's annual inflation rate. In America, however, the pressure is broad-based. "Core" consumer prices, which strip out food and energy prices, rose at an annual rate of 6.5% in March.

Core inflation is one way to assess the breadth of price surges. Another is to exclude the items for which prices have swung the most, typically owing to idiosyncratic factors. The Dallas Fed, for instance, constructs a "trimmed mean" measure, which sorts the components of the personal-consumption expenditures index (the Fed's preferred gauge of prices) by their inflation

rates, and drops the bottom 24% and the top 31%. On that measure inflation has risen by 3.6%—still above the central bank’s target, but by much less.

The problem with trimmed means, however, is that they involve abrupt cliffs, lopping off the top and bottom of the index while giving adjacent percentiles their full weight. In November *The Economist* devised an alternative index, which applies smooth weights. Components with inflation near the median get the most emphasis, and those with the most dramatic price changes get the least. Our measure suggests an inflation rate of close to 6%—hot enough to keep Jerome Powell, the Fed’s chairman, sweating at night. ■



普遍问题

美国消费价格以自1981年以来的最高速飙升

通胀正全面扩大

不幸的经济通常各有各的不幸。然而，现在大多数国家都忙着对抗同一个敌人：消费价格飞涨。据4月12日公布的数字，美国3月份消费价格同比上涨8.5%，是自1981年以来的最高增速。英国和欧元区的消费价格在截至3月的一年内分别上升了7%和7.5%。大多数富裕和新兴经济体目前的通胀水平也远高于各自央行的目标。

在经历了一段通胀过低的时期后，2020年夏天，美联储表示将暂时容忍通胀略高于它2%的目标，希望弥补之前的通胀过低。在随后20个月里，美国消费价格涨幅超出了美联储让长期平均通胀能达到2%的水平，令该行面对快速加息的压力。

在许多地方，当前整体通胀中有很很大一部分源自能源价格的上涨，在俄罗斯入侵乌克兰后，大宗商品市场受到冲击，能源价格飙升。欧元区3月的年通胀约有一半源自能源价格上涨。而在美国，通胀压力却源自方方面面。剔除食品和能源价格的“核心”消费价格在3月的年增速达到6.5%。

核心通胀是评估价格飙升广度的其中一种方式。另一种方式是排除价格波动最大（通常由特殊因素造成）的项目。例如，达拉斯联储构建了“截尾均值”衡量指标，对个人消费支出指数（美联储首选的价格衡量标准）的各个项目按它们的通胀率高低排序，然后去掉头部的24%和尾部的31%。按这个指标计算，通胀升幅为3.6%，仍高于美联储目标，但幅度小得多。

然而，截尾均值的问题是“断崖式”切割，截去了指数的首尾，却赋予与之相邻的百分位完整的权重。去年11月，《经济学人》设计了一个采用平滑加权法的替代指数。通胀接近中位数的部分权重最高，而价格变化最剧烈的部分权重最低。我们的指标显示通胀为接近6%，过热的程度足以令美联储主席鲍威尔夜不能寐。 ■



Balance-sheet manoeuvres

The Federal Reserve prepares for quantitative tightening

Goodbye, QE. Hello, QT

QUANTITATIVE EASING, or QE, once an unconventional tool of monetary policy, has become commonplace over the past decade. During the pandemic alone the Federal Reserve bought a staggering \$3.3trn in Treasuries and \$1.3trn in mortgage-backed securities as it sought to keep borrowing costs low. The reverse process, quantitative tightening (QT), when central banks shrink their balance-sheets, has been far rarer. The Fed is the only central bank to have truly attempted it, and it had to stop abruptly in 2019 because of market ructions. So its plan for reducing its assets—trailed in the minutes of its meeting in March, published on April 6th—takes it into relatively uncharted territory.

Officials like to downplay the significance of QT. When at the Fed's helm, Janet Yellen compared it to watching paint dry. Jerome Powell, her successor, says it will operate in the background. In truth it is akin to dismantling an auxiliary engine for the economy, with only hazy knowledge of the consequences.

As Lael Brainard, a member of the Fed's board, noted on April 5th, this round of QT will be more aggressive than the Fed's previous iteration. With inflation racing ahead and the labour market tight, the central bank wants to cool the economy quickly. Coupled with interest-rate rises, QT is likely to be a drag on growth.

So far the Fed has reinvested the proceeds of maturing bonds in order to maintain its stock of assets. The minutes suggest it is likely to shrink its balance-sheet not by making active sales, but by letting some maturing bonds "roll off", without reinvestment. The roll-off may start in May. Come

July, all going well, the Fed will raise the maximum roll-off to \$95bn per month, split between \$60bn of Treasuries and \$35bn of mortgage-backed bonds. At full tilt, the Fed could shrink its balance-sheet by more than \$1trn over a 12-month period, twice as fast as its first go at QT. “Even if it’s done in a predictable way, this is a big adjustment for markets,” says Brian Sack of D.E. Shaw, an investment firm.

Multiple rounds of bond-buying by central banks since the financial crisis of 2007-09 have yielded some understanding of how QE works. It signals a commitment to ultra-low interest rates. It suppresses long-term rates. And it supports liquidity, ensuring that markets operate smoothly.

QT looks like QE in reverse. Instead of creating central-bank reserves (held by the private sector) by purchasing bonds, the central bank drains reserves by refraining from reinvesting as bonds mature. The three channels through which QE works also operate in reverse. First, QT sends a signal that rate rises are coming. Notably, it was in early January, when the Fed discussed a faster approach to QT than many had expected, that market rates shot up.

The second channel— QT’s direct impact on yields—involves heroic guesstimates. Some analysts think the Fed will shrink its balance-sheet by \$3trn over the next three years (taking it to about 20% of GDP, down from 36% now). Mark Cabana of Bank of America reckons this could equate to anywhere between a quarter point and 1.25 percentage points of rate increases—a remarkably wide range. Mr Powell has also noted the uncertainty about QT: “We have a much better sense, frankly, of how rate increases affect financial conditions.”

When the Fed raises interest rates, it is raising overnight borrowing rates, which then ripple along the yield curve. With QT, the main impact is on longer-term yields. For some economists, such as Kristin Forbes of the

Massachusetts Institute of Technology, this means that QT could be more potent than rate rises, since it would target hot segments of the credit market, such as mortgages. The Fed has said that it will stick with rate increases—the devil it knows—as its main tool. If, however, QT does hit longer yields, it may need fewer rate rises to tame inflation.

The final channel is liquidity. As the Fed buys fewer bonds, there may be fewer transactions overall. Indeed, a Bloomberg index that measures the ease of trading Treasuries recently worsened to levels last seen at the pandemic's start. That echoes uncomfortably with the past round of QT, which culminated in a liquidity crunch in the overnight-borrowing market. But the Fed is better prepared this time. There is much more cash in the market to begin with. And the Fed has set up an overnight-lending facility, which should let banks get funds if needed. “The risk of a spike in rates like we had in September 2019 is much, much lower,” says Bill Dudley, former president of the New York Fed.

Yet new concerns will emerge. The Fed's mortgage bonds have long tenors, so passive roll-offs would take decades. The central bank may have to make active sales, which it wants to avoid. Another concern is the Fed's \$326bn in short-term Treasury bills. Some observers think it will roll them off, supercharging QT; others fear that would stoke volatility. But the biggest worry is whether QT will work as intended, taking heat out of the economy without causing undue harm. ■



缩表特技

美联储准备实施量化紧缩

挥别QE，迎接QT

量化宽松（QE）曾经是货币政策中的非常规工具，在过去十年里已经成了常用手段。仅在新冠疫情期间，美联储为让贷款成本保持低位就购买了3.3万亿美元的美国国债和1.3万亿美元的抵押贷款支持证券，规模惊人。QE的反向操作是量化紧缩（QT），也就是央行缩减其资产负债表，这项操作要少见得多。美联储是唯一真正尝试过QT的央行，而且在2019年时由于市场骚动被迫戛然而止。所以它缩减资产的计划（4月6日公布的3月会议纪要中有所透露）正将它带入一片相对陌生的领域。

官员们总喜欢淡化QT的重要性。耶伦执掌美联储时曾把它比作盯着油漆慢慢变干。她的继任者鲍威尔表示，QT只会在后台默默运行。事实上，QT相当于把经济的一台辅助引擎拆除掉，而这么做会有什么后果大家并不清楚。

正如美联储理事莱尔·布雷纳德（Lael Brainard）4月5日指出的那样，这一轮QT将比前一次更加激进。在通胀飙升和劳动力市场吃紧之际，美联储希望让经济迅速降温。与加息的作用叠加，QT很可能会拖累经济增长。

到目前为止，美联储一直都把持有到期的债券再投资，以维持其资产存量。会议纪要显示，美联储很可能不会通过主动出售来缩表，而是等部分债券自然到期后不做再投资，从而达到“被动缩表”。这种操作可能从5月开始。一切顺利的话，到7月美联储将把被动缩表限额提高至每月950亿美元，包括600亿美元美国国债和350亿美元抵押贷款支持债券。在全力以赴的情况下，美联储可以在12个月内将其资产负债表缩减逾1万亿美元，相当于第一次实施QT速度的两倍。“即使以可预测的方式进行，这也是市场的一次重大调整。”投资公司德劭（D.E. Shaw）的布莱恩·萨克（Brian Sack）表示。

自2007至2009年金融危机以来，各国央行进行了多轮买债操作，这让人们对QE的运作规律有了一些了解。它传达出对超低利率的坚守。它抑制长期利率，支持流动性，确保市场平稳运行。

QT看起来就像QE的逆向操作。央行不再买债来创造央行储备（由私营部门持有），而是在债券到期时不做再投资，从而达到消耗储备的效果。QE发挥功能的三个渠道也会反向运作。首先，QT发出即将加息的信号。值得注意的是，当美联储在1月初讨论以一种比许多人预期更快的方式来实施QT时，市场利率应声急升。

第二个渠道是QT对收益率的直接影响，而这只能依靠大胆猜测。一些分析师认为，美联储将在未来三年将其资产负债表缩减3万亿美元（使之占GDP的比例从目前的36%降至20%左右）。美国银行的马克·卡巴纳（Mark Cabana）估计，这可能相当于加息0.25到1.25个百分点——这个范围相当宽泛。鲍威尔也指出了QT的不确定性：“坦率地说，我们对加息如何影响金融状况的了解要清楚得多。”

当美联储加息时，实际上是在提高隔夜拆借利率，而后逐步传导到整个收益率曲线。而QT主要影响的是较长期的收益率。在麻省理工学院的克里斯汀·福布斯（Kristin Forbes）等经济学家看来，这意味着QT可能比加息更有效，因为它可以针对抵押贷款之类的信贷市场的热点领域。美联储已经表示将坚持以加息为主——这是它熟悉的工具。然而，如果QT确实影响到较长期的收益率，也许它可以用较少的加息频率就抑制住通胀。

最后一个渠道是流动性。随着美联储减少买债，整体交易量可能也会缩小。事实上，彭博一项衡量美债交易便利度的指数最近已经恶化，跌至疫情爆发之初的水平。令人不安的是，这与上一轮QT的情况十分相似，当时最终导致了隔夜拆借市场的流动性危机。但这次美联储的准备更加充分。首先，当前市场上的现金要充裕得多。其次，美联储设立了隔夜借贷便利，让银行在必要时可以获得资金。“发生2019年9月那种利率飙升的风险要低很多很多。”纽约联储前主席比尔·达德利（Bill Dudley）表示。

然而，新的忧虑仍将浮现。美联储的抵押债券期限较长，因此被动缩表将需要几十年的时间。美联储恐怕还是得主动出售，而这是它想要避免的。另一个担忧是美联储持有的3260亿美元短期国债。有观察人士认为这些债券将会被动减持，让QT进程大大加速；也有人担心这将引发市场波动。但最大的担忧是QT能否发挥预期的作用，在不造成过度伤害的情况下为经济降温。 ■



Schumpeter

Save globalisation! Buy a Chinese EV

Electric cars can help stop the world from decoupling

SCHUMPETER IS NOT a car owner. He bought his last one, a diesel-fuelled Volkswagen, in 2015, days before the emissions-cheating scandal erupted. He was so appalled that when the car's engine caught fire he vowed never to buy another and took to a bike instead. He has lived in emissions-free smugness ever since. At least he did—until increasing numbers of electric vehicles (EVs) started to swish past, signalling even more virtue. Now his car envy has returned—but with a dilemma. Some of the most appealing EVs in Europe are either made in China (Tesla) or by Chinese-owned firms (MG). Given concerns about the decoupling of trade into ideological blocs, should that be a dieselgate-sized worry?

To answer that question, first examine what is known in China as “the catfish effect”, the idea that a predator makes weaker rivals swim faster. For years China led the world in production and purchase of EVs. However, the cars were heavily subsidised and shoddy. They were a response to the government's desire to scrub the air and leapfrog the internal-combustion engine, a technology in which China was a laggard. Delighting customers was an afterthought. No Chinese EV-maker was as world-beating as Huawei became in smartphones—before America blackballed it in 2019.

That same year Tesla set up shop in Shanghai and began rolling Model 3s off the production line. It became, says Gregor Sebastian of the Mercator Institute for China Studies in Berlin, the epitome of a catfish. The effect was similar to the benefit that production of Apple's iPhone in China brought to the country's smartphone market, where local suppliers had to raise their game to meet international standards. Chinese carmakers' ambitions likewise rose. The result has been an accelerated shift towards

electrification. BYD, a battery manufacturer turned China's biggest seller of EVs and hybrids, said on April 4th that it had ceased making full combustion-engine vehicles. As with Tesla, its sales are booming.

As yet, no Chinese EV-maker is an export powerhouse. Stockmarket analysts are playing up the potential, hoping this will bring Tesla-like valuations, says Tu Le of Sino Auto Insights, a consultancy. But most of China's EV exports are by wholly foreign brands, such as Tesla, or those with Chinese partners, such as BMW. Foreign marques account for most of the 296,000 Chinese-made EVs and plug-in hybrids sold abroad last year—more than quadruple the number in 2020. Because of high American tariffs, the favourite destinations are Europe and South-East Asia.

China's biggest EV firms are adopting a variety of export strategies to catch up. SAIC, a state-owned car company, is making inroads in Europe under the cover of MG, a classic British sports-car brand that it bought in 2007. It keeps its Chinese identity hidden behind the alluring octagonal nameplate, which may be why sales hit more than 52,000 in Europe last year, double the year before, many of which were EVs. BYD, as well as Nio, which hopes to take on luxury marques like Mercedes, have made EV-friendly Norway the springboard for their forays into Europe. In South-East Asia the strategy is to “attack the villages to surround the cities”, says Scott Kennedy of the Centre for Strategic and International Studies, a think-tank in Washington. That means selling low-cost EVs where Western companies do not venture, in order to strengthen supply chains. Taxi fleets are a popular target for firms like BYD.

Until recently it was considered a long shot that such low-cost brands could penetrate developed markets as well as developing ones. The EV market in China includes scores of also-rans and it begs for consolidation. The firms lack the overseas sales networks of global rivals. Yet they have their own built-in advantages, including access to the best battery supply in the world

and in some cases more sophisticated software than European rivals. China is also taking international safety standards more seriously.

If its EV-makers thrive, it would be good for more than just the car market. The more high-quality Chinese products appeal to international consumers, the more of a stake China has in preserving global trade. EVs encompass many of the strategic tensions that burden the trading system. They are heavily reliant on semiconductors, which has become a sore point in China, and on batteries, Chinese dominance of which is a bugbear for the West. They are hugely subsidised. The harvesting of personal information to improve traffic routes, charging and self-driving technology raises thorny questions about privacy, data storage and cyber-security. The EV industry is also exposed to trade wars: since 2018 America has levied 25% tariffs on Chinese battery cells, electric motors and other EV components. The European Union, with its green agenda, is less overtly protectionist for once.

Most Western carmakers have enough of a stake in keeping supply chains open, and in maintaining access to China's own market, that they would prefer not to erect more trade barriers. They know, however, that China is using them as catfish to improve its own industry. At any point it could decide that they have done their job. That could throw the entire global market, including China's, into turmoil.

| *Completing the circuit*

Yet the catfish effect can work in both directions. Last month Bloomberg reported that CATL, China's battery behemoth, was considering building a \$5bn factory in North America. In response Jim Greenberger of NAATBatt International, a battery trade body, said he would welcome this as long as CATL brought battery-manufacturing tech and know-how in order to foster technology transfer to American firms.

That, of course, is the magic of globalisation. Over time, competition and co-operation lead to the exchange of ideas, benefiting all. It will not last if geopolitical tensions, heightened by Russia's pounding of Ukraine, splinter the world economy into competing blocs. If buying a Chinese car feels unfamiliar, remember that you are supporting globalisation. Not bad as fringe benefits go. ■



熊彼特

拯救全球化！买辆中国电动车吧

电动汽车有可能阻止世界脱钩

笔者目前没有车。上一辆是在2015年买的大众柴油车，买下没几天大众的排放作弊丑闻就爆发了。他大为惊骇。当那辆车的引擎起火时，他发誓再也不买车了，改骑自行车。从那以后，他一直生活在零排放的沾沾自喜之中。至少他个人是这样——直到越来越多的电动汽车开始疾驰而过，彰显着更高尚的品德。现在，他看见汽车又重新眼热了起来，但还是左右为难。欧洲最吸引人的一些电动汽车要么是中国制造（特斯拉），要么是中国公司制造的（名爵）。想到贸易体系有脱钩成以意识形态划界的危险，难道不和“柴油门”一样令人忧心吗？

要回答这个问题，先来仔细看看中国人所说的“鲶鱼效应”，也就是认为引入一个捕食者会迫使弱小的对手游得更快。多年来，中国在电动汽车的生产和购买上领先全球。然而，这些车是大量补贴的结果，且质量低劣。它们只是在顺应政府两方面的愿望：净化空气，还有大步跨越内燃机这一中国落于人后的技术。让顾客满意并非首要考虑。没有一家中国的电动汽车制造商做到了全球顶尖，像华为在智能手机领域那样——当然是在2019年它被美国“拉黑”之前。

同一年，特斯拉在上海设立了工厂，Model 3开始走下那里的生产线。柏林墨卡托中国研究所（Mercator Institute for China Studies）的格雷戈尔·塞巴斯蒂安（Gregor Sebastian）说，特斯拉成了典型的鲶鱼。这种效应类似于苹果在中国生产iPhone给中国智能手机市场带来的益处：本土供应商不得不提高自己的水平以达到国际标准。中国的汽车制造商也同样雄心高涨。结果就是加速了向电气化的转变。电池制造商比亚迪已成为中国销量最高的电动汽车和混合动力汽车制造商，它在4月4日宣布已经停止生产全内燃机汽车。和特斯拉一样，它的销量也在飙升。

目前为止还没有一家中国电动汽车制造商成为出口大户。咨询公司中国汽

车洞察（Sino Auto Insights）的涂乐说，股票市场的分析师们正在渲染中国电动汽车产业的出口潜力，希望这会造就类似特斯拉那样的估值。但中国大部分电动汽车出口都是由纯外国品牌（如特斯拉）或者是中外合作的品牌（如宝马）达成的。去年有29.6万辆中国造电动汽车和插电式混合动力汽车销往海外，是2020年的四倍多，其中外国品牌占了大部分。由于美国的高关税，这些车最爱的去处是欧洲和东南亚。

中国最大的那些电动汽车公司正采取各种出口策略来迎头赶上。国有企业上汽集团正打着2007年收购的英国经典跑车品牌MG的幌子进军欧洲。它将自己的中国身份隐藏在迷人的八角形铭牌后面，这可能是它去年在欧洲的销量突破5.2万辆（其中许多是电动汽车）、较前年翻了一番的原因。比亚迪和希望挑战梅赛德斯等豪华品牌的蔚来已经把对电动汽车友好的挪威作为进军欧洲的跳板。华盛顿智库战略与国际研究中心（Centre for Strategic and International Studies）的斯科特·肯尼迪（Scott Kennedy）说，它们在东南亚的策略是“农村包围城市”，也就是在西方公司不敢涉足的地方销售低成本电动汽车，以加强供应链。出租车车队是比亚迪等公司积极争取的目标。

直到最近，人们还认为这些低成本品牌没什么可能做到发展中国家和发达国家通吃。中国的电动汽车市场上有一大批陪跑的品牌，迫切需要整合。这些公司缺乏全球竞争对手的海外销售网络。不过它们有自己的内在优势，包括能获得世界上最好的电池供应，有时也拥有比欧洲竞争对手更先进的软件。中国也越发重视国际安全标准。

如果中国的电动汽车制造商能茁壮成长起来，带来的益处将不仅限于汽车市场。高品质的中国产品对国际消费者越有吸引力，维护全球贸易对于中国就越利害攸关。在电动汽车上可以看到诸多令贸易体系承压的战略冲突。它们高度依赖半导体和电池，前者已成为中国的痛点，而中国在后者上的主导地位是西方的心头大患。它们得到了高额补贴。它们还收集个人信息以改善交通路线、充电和自动驾驶技术，引发了关于隐私、数据存储和网络安全的棘手问题。电动汽车产业也受到贸易战的影响：自2018年起，美国对中国的电池、电机和其他电动汽车零部件征收25%的关税。致

力推动“绿色议程”的欧盟这回总算不那么公然搞保护主义了。

保持供应链开放、能继续进入中国市场对大多数西方车厂都很重要，因此它们倾向于别再有更多贸易壁垒。但它们也知道，中国是在拿自己充当鲶鱼来提升它自己的产业。它随时都有可能认定它们该做的事已经做完了。这可能会让整个全球市场陷入混乱，而中国自己也不能幸免。

| 完成电路

但鲶鱼效应也可能是双向的。上月彭博报道称，中国电池巨头宁德时代正考虑在北美投资50亿美元建一家工厂。对此，电池行业团体美国国家先进技术电池联盟（NAATBatt International）的吉姆·格林伯格（Jim Greenberger）表示，只要宁德时代能带来电池制造技术和诀窍，实现向美国公司的技术转移，他将对此表示欢迎。

这当然就是全球化的魔力了。假以时日，竞争和合作会促成思想创意的交流，让所有人都受益。如果因俄罗斯袭击乌克兰而加剧的地缘政治紧张将世界经济分裂成相互竞争的阵营，这种局面就不会持续。如果你对买中国车还不太适应，记得你这么做是在支持全球化。想想这附加的好处，其实也不赖了。■



Recession roulette

A toxic mix of recession risks hangs over the world economy

American inflation, Europe's energy crisis and China's Omicron outbreak threaten the world economy with a downturn

JUST A YEAR ago the world's economists were celebrating a rapid rebound from recession. Now they are worrying that the next downturn could be looming. In America the Federal Reserve is preparing to do battle with high inflation by raising interest rates sharply and shrinking its balance-sheet. In Europe expensive energy is sapping consumers of spending power and making factories costlier to run. And in China an outbreak of the Omicron variant of the coronavirus has led the authorities to impose the strictest lockdowns since the start of the pandemic.

It is a gloomy combination for global growth, and the outlook is darkening. Several economies could even suffer recessions, though at different times depending on the obstacles they face.

The economy in the United States is overheating. The annual rate of consumer-price inflation is 7.9% and hourly wages are 5.6% higher than they were a year ago. America has nearly twice as many job openings as it does unemployed workers—the highest ratio in 70 years. For much of 2021 central bankers hoped that Americans who left the labour force after the pandemic struck would return, helping cool the labour market. In the past six months their prayers have been answered: more than half the missing workers of prime working age have returned. Yet wage growth has risen anyway, perhaps because workers are negotiating hard as rising prices erode living standards.

The Fed needs both wage and price growth to cool if it is to hit its 2% inflation target. It is expected to raise short-term interest rates, which

started the year below 0.25%, to over 2.5% by December, and to continue to raise rates above 3% in 2023. Earlier this month the central bank trailed a plan to shrink its \$8.5trn bond holdings, starting in May, at a much faster pace than during the last period of “quantitative tightening”.

Hitting the monetary brakes, though necessary, endangers growth. History suggests that the Fed finds it difficult to cool the jobs market without eventually tipping the economy into recession. It has pulled off a “soft landing” only three times since 1945. And it has never done so while battling high inflation. Bond investors are betting that in two years’ time the Fed will have to cut rates again as the economy weakens. Given the record, a recession in the next two years looks likely.

Europe has an inflation problem, too, but it is so far caused by expensive imported energy and food more than by overheating. Russia’s invasion of Ukraine and Western sanctions threaten the continent’s energy supply. Gas prices for next winter are five times higher than in America, and spending on household energy is almost twice as high as a share of GDP (partly because Europe is poorer). As energy prices have surged, consumer confidence has slumped. Firms are struggling, too: French industrial production fell in February.

The euro area’s economy will probably still grow in 2022 as a whole. But it looks fragile. Should Europe stop importing Russian gas—whether because it chooses to or the Kremlin decides to cut off the supply—the danger of a recession will rise.

The threat to global growth from China’s Omicron outbreak is the most severe and immediate. China reported over 20,000 new cases of the virus on April 6th. Because the government is committed to eliminating covid-19, Shanghai’s 26m residents, and those of other big cities with outbreaks, are under lockdown. If the past relationship between lockdowns

and GDP holds, China's real-time output will be 7.1% lower than in a world with no restrictions, according to Goldman Sachs. Lockdowns will also disrupt global trade, which is still struggling with a hangover from earlier in the pandemic. Shanghai is the latest global port to see hundreds of ships back up offshore, waiting to load or unload.

Xi Jinping, China's president, has urged officials to cut the costs of its restrictions. But if it opens up too soon, mainland China will see a wave of infection and deaths like that which recently plagued Hong Kong. That would scare consumers and become a source of economic disruption in its own right. Until China vaccinates its elderly in sufficient numbers using the most effective jabs, lockdowns will be an enduring feature of its economy and a source of global volatility.

The blame for the world economy's many troubles lies squarely with policymakers. The Fed's job is supposed to be to take away the punchbowl just as the party gets going; it has instead presided over a blowout. Europe's governments let the continent become dependent on Russian natural gas. And China's difficulty in suppressing Omicron was predictable, and widely predicted. Economic trouble often strikes as a bolt from the blue. Today's recession scare was avoidable. ■



【首文】衰退轮盘赌

世界经济面临多重衰退风险叠加

美国通货膨胀，欧洲能源危机和中国奥密克戎爆发可能把世界经济拽入衰退

就在一年前，经济学家还在庆贺世界经济从衰退中迅速复苏。现在，他们开始担心新一轮衰退即将来袭。在美国，美联储正准备通过大幅加息和缩表来对抗高通胀。在欧洲，能源价格飙升打击了消费者的购买力，推高了工厂的运营成本。而在中国，奥密克戎毒株的一轮爆发促使当局实施了自疫情发生以来最严格的封控措施。

这些因素互相叠加，给全球经济增长蒙上了阴影，前景愈发暗淡。一些经济体甚至可能陷入衰退，尽管由于面临的障碍各不相同而不会同步发生。

美国经济处于过热状态。消费者价格年通胀率达到7.9%，时薪水平较一年前高出5.6%。美国的空缺职位几乎是失业人数的两倍——为70年来最高比率。在2021年的大部分时间里，美联储官员都寄望于那些在疫情爆发后退出就业的美国人能回归，给劳动力市场降降温。过去六个月里他们的愿望实现了：超过半数的离职壮年工人已经重新就业。但工资无论如何都还是上涨了，或许是因为物价上升降低了生活水平，使得工人的涨薪要求强烈。

要达到美联储设定的2%的通胀目标，工资和物价增长需要双双降温才行。今年伊始，短期利率还不到0.25%，但预计美联储将在12月之前把它提高至2.5%以上，并在2023年继续上调至超过3%。本月稍早时，美联储暗示将从5月开始缩减其持有的8.5万亿美元债券，速度将远远快于上一次“量化紧缩”。

踩下货币刹车尽管有必要，却会危及经济增长。历史经验表明，美联储给就业市场降温的同时最终难免将经济拖入衰退。自1945年以来，美联储仅成功实现过三次“软着陆”。而且其中无一是在对抗高通胀时实现。投资者正在押注随着经济走弱，两年内美联储将不得不又降息。鉴于以往的记

录，未来两年出现衰退的概率不小。

欧洲也有通胀的问题，但到目前为止，主要是由进口能源和食品价格高涨所致，而并非经济过热。俄罗斯入侵乌克兰以及西方的制裁都威胁着欧洲大陆的能源供应。下个冬天的天然气价格是美国的五倍，家庭能源支出占GDP的比例接近美国的两倍（部分原因是欧洲不如美国富裕）。随着能源价格飙升，消费者信心遭到重创。企业也在挣扎：法国工业生产在2月出现下滑。

欧元区经济整体上在2022年仍可能增长。但这一点并不牢靠。如果欧洲停止进口俄罗斯天然气——无论是主动为之还是克里姆林宫决定断供——经济衰退的危险会上升。

中国的奥密克戎疫情对全球经济增长的威胁最为严重和紧迫。4月6日，中国报告了两万多例新增病例。由于政府坚持“清零”政策，上海2600万居民以及其他爆发疫情的大城市都处于封控中。高盛认为，根据以往封锁和GDP之间的关系来看，中国的实时经济产出将比没有封控限制的情况降低7.1%。封控还将进一步扰乱全球贸易，而贸易原本还在承受前段疫情的遗留问题。许多国际大港口都有数百艘船舶拥堵在近海等待装卸货物，上海成为了最新的一个。

中国国家主席习近平要求官员降低防控措施的代价。但如果放开得太早，中国大陆将出现一波感染和死亡潮，正如最近饱受折磨的香港那样。这会让消费者受到惊吓，本身也会扰乱经济。在中国使用最有效的疫苗实现足够高的老年人接种率之前，封控将成为中国经济的持久特征，并给全球造成波动。

世界经济的众多问题完全应该归咎于政策制定者。美联储的职责应该是在宴会渐酣时撤走酒杯，但它却举办了一场狂欢。欧洲各国政府放任整个大陆陷入对俄罗斯天然气的依赖。中国难以遏制奥密克戎是可预见的，也被广泛预测到了。经济困境经常像晴天霹雳一般突然来袭。但今天的衰退恐慌原本是可以避免的。 ■



Stand-up comedy

Phil Wang's jokes are seriously funny

The subtly daring comedian is having a moment

DURING HIS stand-up set at the London Palladium, Phil Wang explored his mixed heritage—his mother is British, his father is Chinese-Malaysian—his love of unusual delicacies and his enthusiasm for male contraception. He closed with some advice for these fractious and sensitive times: in particular, on how to gauge “whether or not it is morally acceptable to do another person’s accent”.

First and foremost, he argued, the speaker must put in the time and effort to make the impression convincing. Beyond that, any country that has had an empire—or was on the “naughty” side in the second world war—is fair game. This “gets you more accents than you think”: as well as many European ones, Chinese, Egyptian, Japanese, Russian and Turkish are permissible. Just the thought of such impersonations makes his left-leaning white friends queasy, he confided. Yet given their country’s vaulting ambitions, for the Chinese, at least, such neuroses are trivial, he insisted. After all, “the eagle does not concern itself with the impressions of the worm.”

Mr Wang is one of Britain’s sharpest and most surprising stand-up comedians, widely known for his observations on race and the legacy of colonialism. The set he performed at the Palladium and elsewhere on his recent tour, called “Philly Philly Wang Wang”, was released on Netflix last year; he embarks on his first American tour, with fresh material, this month. His new memoir, “Sidesplitter: How To Be From Two Worlds At Once”, includes incisive essays on language, cultural assimilation and dating. Meanwhile “BudPod”, a podcast co-hosted with Pierre Novellie, a fellow comedian, has exceeded 2m downloads since its debut in 2019.

His life and career are an accident of history, both grand and intimate. Britain controlled parts of the Malay peninsula between the 18th and mid-20th centuries; it was exerting a softer kind of power by the time Mr Wang's mother, an anthropologist, joined the Voluntary Service Overseas. She was posted to northern Borneo where she met Mr Wang's father, a martial-arts teacher. The comedian was born in 1990 in Stoke-on-Trent in central England, but his family returned to Malaysia soon afterwards. In his book he interweaves their story with that of Kota Kinabalu, the city in which he grew up, and his attitude towards his own identity. "For an enterprise so heavily associated with death," he writes, "I ironically owe the British Empire my life."

He acknowledges a debt to British comedy, too. From a young age he watched shows like "Blackadder" and "French and Saunders" (while admiring Harith Iskander, the "godfather of stand-up comedy in Malaysia"). Comedy was a safe haven during tough years at a Chinese school, where there was a "constant threat of physical pain" from corporal punishment. This period shaped his career in another way. "I became really introverted and quite afraid of speaking out," he says, leaning back and closing his eyes, as if recoiling from the memory. "Then finding stand-up, it was this form of communication that I thought I could do. I felt I could earn the right to speak by writing something funny."

Moving back to Britain in his teens, Mr Wang took part in his first comedy night at school. Most of the material was borrowed: "I didn't realise at the time you had to write your own jokes." He went on to Cambridge University, which had a thriving comedy scene, and became president of the Footlights, an incubator of entertainment greats including Eric Idle and Hugh Laurie. In 2010 he won the prestigious Chortle Student Comedy Awards. Steve Bennett, editor of Chortle, a comedy website, recalls his cool delivery, self-deprecating jokes and "intricate, detached wordplay".

That accolade helped Mr Wang make comedy a full-time job. He has since appeared on assorted television and radio programmes and, alongside his stand-up gigs, performed with a sketch group called Daphne. He has encountered bigots as well as fans. In one painful passage in “Sidesplitter”, he describes how a woman in the audience once loudly announced that he was unattractive because of his ethnicity. The incident confirmed his comic vocation, he says, making him even surer “that British society would benefit from an outspoken East Asian making jokes about himself from a place of authority”.

Mr Novellie, his collaborator on “BudPod”, likens Mr Wang’s ability to take on subjects such as race to that of American counterparts such as Dave Chapelle. As well as their joint interest in history, films, games and scatological mishaps, Mr Novellie—who was born in South Africa and brought up on the Isle of Man—suggests he and Mr Wang share an “outside perspective”. That means that when they discuss subjects like the Elgin Marbles, ancient Greek sculptures currently held in the British Museum, they are not constrained by the sense of national embarrassment that many of their liberal peers exude.

For his part, Mr Wang denies that comedy has a political duty. He says he mostly strives to entertain, encourage listeners to take themselves less seriously and point out jarring truths—such as, in his bit about impressions, Chinese people being considered a “very vulnerable minority” in Britain while also being linked to a “globally very powerful” country. Yet, intentionally or otherwise, he is a subtle champion of nuance and balance.

He uses the set-ups of jokes, and the sudden switch of a punchline, to undermine preconceptions about people and places. Perhaps, he says, the gags would come easier if he were more polemical. “It’s much more funny to have a really strong opinion about something and scream about it, than it is to say: ‘But let’s look at this from the other perspective,’” he concedes.

“But I don’t. I can’t.” ■



单口喜剧

菲尔·王正经地搞笑

这位大胆得恰到好处的喜剧演员风头正劲

在伦敦帕拉丁剧院（London Palladium）的单口喜剧表演中，菲尔·王（Phil Wang）探讨了她的混血血统——母亲是英国人，父亲是马来西亚华人，还有她对稀奇古怪的美食的热爱，对男性避孕的热衷。在结尾，他给这个易怒又敏感的时代提出了一些建议，尤其是如何判断“模仿别人的口音在道德上是否可接受”。

他认为，首要的一点是模仿者得花点时间和精力让自己的表演逼真。除此之外，任何曾经建立过帝国的国家——或是二战中站在“作恶”一边的国家——都是可以开玩笑的对象。“你都想不到这给了你多少可以模仿的口音”：除了许多欧洲国家的口音外，中国的、埃及的、日本的、俄罗斯的、土耳其的都可以。他透露，他的左倾白人朋友们光是想到这样的模仿都如坐针毡。不过考虑到中国的凌云壮志，他坚信至少对中国人来说，这样的神经敏感不值一提。毕竟，“雄鹰才不关心虫子怪模怪样地模仿自己呢”。

菲尔是英国最尖锐、最让人惊讶的单口喜剧演员之一，以对种族和殖民主义遗留问题的观察闻名。他近年在帕拉丁剧院等地名为“我就自恋”（Philly Philly Wang Wang）的巡演去年在奈飞上架；本月，他带着新鲜的素材开始了第一次美国巡演。他的新回忆录《笑到裂开：如何同时来自两个世界》（Sidesplitter: How To Be From Two Worlds At Once）汇集了关于语言、文化同化和约会的犀利文章。此外，他和喜剧演员皮埃尔·诺维利（Pierre Novellie）共同主持的播客“BudPod”在2019年首次推出，迄今下载量已超过200万次。

他的人生和事业是历史的偶然——既有大历史也有个人际遇。英国在18世纪到20世纪中期控制着马来半岛的部分地区；到了菲尔的母亲——一位人类学家——加入海外志愿服务（Voluntary Service Overseas）时，它开始

施加一种更“软”的影响力。她被派往婆罗洲北部，在那里遇到了菲尔的父亲，一位武术教师。1990年，在英格兰中部的斯托克城（Stoke-on-Trent），菲尔出生了。但他们全家很快就回到了马来西亚。在书中，他家人的故事、他长大的城市哥打基纳巴卢（Kota Kinabalu）的故事，还有他对自己身份的态度交织在一起。“大英帝国这份伟业不知葬送了多少条生命，”他写道，“我这条命却全拜它所赐，讽刺啊。”

他承认自己还欠英国喜剧一份情。年幼时他看《黑爵士》（Blackadder）和《弗兰奇与桑德斯》（French and Saunders）这样的节目（同时也仰慕哈里斯·伊斯坎德[Harith Iskander]这位“马来西亚脱口秀教父”）。在华文学校的日子很不好过，“时时刻刻都在害怕受体罚的皮肉之苦”，喜剧成了他的避风港。这段时光还以另一种方式塑造了他的事业。“我变得非常内向，特别害怕开口说话。”他说着，身体后倾，闭上眼睛，仿佛往事不堪回首。“后来我找到了单口喜剧，觉得这种交流方式我还应付得来。我觉得我可以写一些有意思的东西，靠这个争取开口说话的权利。”

十几岁时，菲尔回到了英国，在学校参加了他的第一个喜剧之夜。大部分素材都是借鉴来的：“我当时还没意识到你得自己写笑话。”后来他入读有一个活跃的喜剧人圈子的剑桥大学，并成为脚灯社（Footlights）的主席，这个社团曾经培养出艾瑞克·爱都（Eric Idle）和休·劳瑞（Hugh Laurie）等娱乐界大腕。2010年，他获得了颇具盛名的“Chortle学生喜剧奖”。喜剧网站Chortle的编辑史蒂夫·班尼特（Steve Bennett）还记得他当时沉静的表演风格、自嘲的笑话和“错综复杂却又超然事外的文字梗”。

这份荣誉帮助菲尔把喜剧变成了一份全职工作。自那之后，他开始出现在各种电视和广播节目中，除了表演单口喜剧，还参加了一个名为“月桂”（Daphne）的喜剧小品（sketch）团体的演出。他不光遇到过粉丝，也遇到过偏执狂。《笑到裂开》中有一段痛苦的讲述：一名女性观众大声说，他的种族身份让他毫无魅力可言。他说，这件事坚定了他做喜剧的决心，让他更加确信“一个直言不讳的东亚人，在有分量的场合，拿自己开玩笑，会让英国社会受益”。

菲尔在BudPod节目的拍档诺维利把他在表达种族等问题上的能力和戴夫·查普尔（Dave Chapelle）等美国同行相提并论。南非出生、在马恩岛（Isle of Man）长大的诺维利认为，自己和菲尔除了同样对历史、电影、游戏和“屎尿屁”笑话感兴趣外，都有一种“旁观者视角”。当两人讨论一些话题时，比如现在收藏在大英博物馆的古希腊雕塑埃尔金大理石雕（Elgin Marbles），不会像很多自由主义的同行那样，因“家丑”的尴尬感而束手束脚。

菲尔自己则不认为喜剧负有政治义务。他说他的主要任务是努力娱乐大众，鼓励听众别太把自己当回事，并且指出一些不和谐的事实——比如他在讲述口音模仿的那段中提到，华裔在英国被认为是“非常脆弱的少数族裔”，同时却又和一个“在全球非常强大”的国家联系在一起。不过，无论有意无意，他在细微差别和平衡上都拿捏得恰到好处。

他用笑话的层层铺垫和突然切换笑点来打破对人和地方先入为主的观念。也许，他说，如果他更好辩，那些梗会更出效果。“对某件事有非常强烈的看法，然后把它大声嚷嚷出来，比说‘但让我们从另一个角度来看这件事’要有趣得多，”他承认，“但我不是这种。我做不到。”■



Another Musk-have

Is investing in Twitter a meme too far for Elon Musk?

The self-styled Technoking may be overextending himself

WHAT WILL he do with it? That was the big question after Elon Musk let it be known on April 4th that he had amassed a stake of 9.2% in Twitter, making him the social-media firm's largest shareholder. Will the world's richest man buy more shares or even take Twitter private? Will the boss of Tesla take a hands-on role in Twitter's management? Will the libertarian troll push to bring back Donald Trump, kicked off the platform after inciting an assault on the Capitol in January 2021? Speculation mounted after Twitter said a day later that Mr Musk would join its board.

As is his wont, Mr Musk will reveal his plans in his own time and probably in his own tweets to the 80m people who follow him on the platform (not many fewer than followed Mr Trump before he got the boot). In posts published before he announced the investment, he complained that Twitter "serves as the de facto public town square" but fails "to adhere to free-speech principles". He urged the company to open up the algorithm that decides which tweets users see. In light of his well-documented sympathies for cryptocurrencies and their underlying technology, the blockchain, he could try to turn Twitter into a decentralised service controlled by users.

It is hard to see how that would make the company more profitable. Investors rejoiced anyway. Some may be believers in the "Elon markets hypothesis", which holds that stocks should be valued based not on fundamentals but on their proximity to Mr Musk. Others may hope that he can really shake things up. Twitter has been a much bigger cultural success than a commercial one. Before Mr Musk's move sent its share price up by a third, the firm's market value had been languishing around \$30bn, not

much higher than where it was when it went public in 2013. By comparison, its social-media rival Meta (née Facebook), briefly became a \$1trn company and its market capitalisation is up more than five-fold in the same period despite a recent tumble (it is currently worth \$631bn).

Whatever Mr Musk's designs for Twitter, one near-certainty is that they will require money, time and attention. That raises another question: is the self-styled Technoking overextending himself?

Financially, he isn't. The investment in Twitter, which cost less than \$3bn, is chump change for Mr Musk—about 1% of his net worth. A bigger concern, especially to investors in his other firms, is over his workload. Twitter comes on top of several big corporate commitments. Besides running Tesla, a \$1.1trn electric-car giant with nearly 100,000 employees, he heads up SpaceX, a privately held rocketry firm valued at \$100bn. He also helped found two drilling startups, one making big holes to build tunnels (The Boring Company), the other making tiny ones to implant electrodes in the brain (Neuralink). Adding a Twitter board seat to his résumé may overtax even a functioning workaholic and astute delegator like Mr Musk. Now 50 years old and the father of eight, he has been putting in 100-hour weeks for decades, as he recently revealed in an interview.

Where Mr Musk may be most over extended is in his trolling—not so much of his numerous critics (though he does plenty of that in his spare time) but of regulators. America's Securities and Exchange Commission was already after him for allegedly violating a court agreement to have his tweets lawyered before publishing, reached after he tweeted in 2018 that he had “funding secured” to take Tesla private, which he ended up not doing.

The Twitter investment may get him into further trouble. He made it public a few days after the deadline for such disclosures. And his filing suggested that he would be a passive investor, which seems at odds with his joining

the board. Expect his Twitter habit to raise even more eyebrows now that he is no longer just a big user but a large shareholder, too. ■



再出马

投资推特这个大梗马斯克玩不玩得了？

这位自封的“电音之王”可别“嗨”过了头

他会拿它来干什么？4月4日伊隆·马斯克公开表示自己已持有推特9.2%的股份，从而成为这家社交媒体公司的最大股东。人们心头升起一个大大的问号。这位世界首富会继续加持股份，甚至把推特私有化吗？这位特斯拉的老板会亲自参与推特的管理吗？这位信奉自由意志主义的嘴炮大王会推动特朗普回归推特吗——去年1月特朗普在煽动攻击国会大厦后被平台封号。4月5日，推特表示马斯克将加入其董事会，一时间猜测四起。

按马斯克惯常的做法，他会在自以为恰当的时间，并且可能是用自己的推特账号向8000万粉丝（不比特朗普被踢出推特前少多少）披露他的计划。在宣布这项投资之前，他曾发帖吐槽推特“实际上是一个公共的城市广场”，却未能“遵守言论自由原则”。他敦促推特开放决定用户能看到哪些推文的算法。鉴于他对加密货币及其底层区块链技术的支持人尽皆知，他可能会尝试把推特转变为一项由用户控制的去中心化服务。

很难想象这如何提高推特的赚钱能力。但投资者仍然欢欣鼓舞。一些人可能是“伊隆市场假说”的信徒。该假说认为，股票的估值不应基于基本面，而应基于它们与马斯克的关联有多紧密。其他人可能希望他真的能扭转乾坤。推特在文化上的成功远远大于在商业上的成功。在马斯克此举将其股价推高三分之一之前，推特的市值一直徘徊在300亿美元左右，不比2013年上市时高多少。相比之下，其社交媒体竞争对手Meta（原Facebook）的市值一度高达一万亿美元，尽管目前因近期的暴跌缩水至6310亿美元，但市值还是在同一时期内增长了五倍多。

无论马斯克对推特作何打算，几乎可以肯定的一点是，它们都需要资金、时间和精力。这又引发了另一个问题：这位自封的“电音之王”（Technoking）会不会“嗨”过头了？

从财务上说，并没有。对推特的投资不到30亿美元，对马斯克来说只是笔小钱——大约是他净资产的1%。投资者更担心的是他忙不忙得过来，尤其是那些往他别的公司投了钱的人。马斯克已经在埋头经营好几家大公司了，现在又添上一个推特。除了掌管着市值1.1万亿美元、员工近10万人的电动汽车巨头特斯拉，他还领导着估值1000亿美元的私有火箭公司SpaceX。他还帮助创立了两家“钻孔”创业公司——一家是钻大洞来建隧道的Boring Company，另一家是钻小孔把电极植入大脑的Neuralink。即便是马斯克这样游刃有余的工作狂——他还很知人善任，简历上再添一个推特董事的职务也可能会劳累过度。今年50岁的他还是八个孩子的父亲，他在近期一次采访中透露，几十年来自己一直都是每周工作100小时。

最让马斯克过分耗神的可能还是他在网上乱开炮——主要倒不是针对他的众多批评者（尽管他在得空时也没少这么干），而是对准监管机构。美国证券交易委员会（SEC）已经对他展开追查，理由是他涉嫌违反一项法庭协议。2018年，马斯克发推文称已经“获得融资”，要把特斯拉私有化，他最终没有这么做。SEC就此事提起的诉讼达成的和解协议要求他的推文在发布前须经律师审核。

对推特的投资可能给他带来更多麻烦。他发布这个消息时，已经过了这类股东信息披露的截止期好几天。他提交的文件表明自己会是个被动投资者，这似乎与他要加入董事会的动作相矛盾。等着瞧吧，他发推文的习惯会愈发让人大跌眼镜，既然现在他不只是大用户，还是大股东了。■



Looking in the side-mirror

Omicron is dealing a big blow to China's economy

For a timely take, analysts are turning to unconventional indicators

OMICRON MOVES fast. That makes it difficult to contain—even for China, which tries to stomp promptly on any outbreak. A cluster of infections in Shanghai, for example, has forced the government to impose a hurried lockdown for which it seems woefully unprepared.

The variant's speed also makes China's economic prospects unusually hard to track. A lot can happen in the time between a data point's release and its reference period. The most recent hard numbers on China's economy refer to January and February. Those (surprisingly good) figures look dated, even quaint. For most of that time, there was no war in Europe. And new covid-19 cases in mainland China averaged fewer than 200 per day, compared with the 23,107 reported on April 7th. Relying on official economic figures is like using a rear-view mirror to steer through a chicane.

For a more timely take on China's economy, some analysts are turning to less conventional indicators. Baidu, a search engine and mapping tool, provides a daily mobility index, for instance. Over the week to April 3rd, this was more than 48% below its level a year ago. The index is best suited to tracking movement between cities, says Ting Lu of Nomura, a bank. To gauge the hustle and bustle within cities, he uses other indicators, such as subway trips. Over the week ending April 2nd, the number of metro journeys in eight big cities was nearly 34% lower than a year ago. In Shanghai, where many subway lines are now closed, the number of trips was down by 93%, a worse drop than in early 2020.

The two numbers that worry Mr Lu most track distribution services. In the week ending April 1st, an index of express deliveries by courier companies

was nearly 27% below its level at a similar point last year. Over the same period, an index of road freight fell by 12.8%. The decline looks especially stark because the measure was rising briskly at the end of last year.

Unconventional measures are all the more valuable in China because of doubts about the official data. The strong figures for January and February, for example, are not only old but odd. They suggest that investment in “fixed” assets, like infrastructure, manufacturing facilities and property, grew by 12.2% in nominal terms, compared with a year earlier. But that is hard to square with double-digit declines in the output of steel and cement. The recovery in property investment also looks peculiar alongside the fall in housing sales, starts and land purchases. When some local governments said that they were double-checking their figures at the behest of the National Bureau of Statistics (NBS) it became clear that the official statistics look odd even to the official statisticians.

China’s high-frequency indicators proved their worth in spring 2020. Economists were timid at first in cutting their growth forecasts. No one knew exactly how the economy would react or what the NBS would be prepared to report. Armed with evidence from high-frequency data, forecasters were eventually brave enough to predict a GDP decline in the first quarter of 2020. Indeed, it shrank by 6.8%, according to even the official figures.

The timeliness of unconventional indicators makes them valuable in periods of flux. Still, “there are many traps,” says Mr Lu. Any short period can be distorted, say by bad weather, or holidays. And annual growth rates can be skewed by past idiosyncrasies. Moreover, what does a dramatic weekly decline in road freight mean for quarterly GDP growth? It is impossible to say with any precision. Many indicators also have only a short history. As a PhD student, Mr Lu was trained in econometrics. “But with only one or two years of data, if I used the kind of techniques I learned

at school, people would laugh at me.”

To help avoid some of the traps, Mr Lu and his team watch “a bunch of numbers”. “If seven or eight out of ten indicators are worsening, then we can be confident that GDP growth is getting worse,” he says. Right now, he thinks, “something must be going very wrong.” ■



看看侧视镜

奥密克戎正对中国经济造成巨大打击

为及时掌握现状，分析师求助于非常规指标

奥密克戎传播速度极快，因而难以遏制，连一贯迅速扑灭疫情火苗的中国也被难倒。例如在上海，成片的感染病例迫使当地政府在看起来毫无准备的不幸情况下匆忙封城。

该毒株的传播速度也让中国的经济前景异常难以追踪。等到关于过去某个时间段的数据发布之时，可能又已经发生了很多事。最新公布有关中国经济的官方数据显示的是1月和2月的情况。这些（好得出乎意料的）数字显得过时甚至怪异。那两个月的大部分时间里，欧洲还没有爆发战争，中国大陆的新增新冠病例平均每天不到200例。而4月7日的新增病例却达到23107例。靠官方数据看经济，就好像看着后视镜过急弯。

为更及时地了解中国的经济情况，一些分析师转向参考一些不太常规的指标，例如由搜索引擎和地图工具百度提供的一个每日人口流动指数。在截至4月3日的一周内，该指数比一年前的水平低超过48%。野村证券的首席经济学家陆挺表示，该指数最适合追踪城市之间的人口流动。他还利用地铁出行次数等其他指标来衡量城市内部的繁忙程度。在截至4月2日的一周内，八个大城市的地铁出行次数比一年前减少近34%。在上海，许多地铁线路现已关停，出行次数下降了93%，下滑比2020年初时更大。

最令陆挺担心的是追踪配送服务的两个指标。在截至4月1日的一周内，反映快递公司配送量的一个指数比去年类似时间点的水平低近27%。同一周，公路货运指数下降了12.8%。因为该指数在去年年底曾急速上升，最近的下跌反差尤为强烈。

在中国，由于官方数据的可信性存疑，非常规指标更显其价值。比如说，1、2月的强劲数据不仅过时，而且奇怪。这些数字显示，对基础设施、生产设施和房地产等“固定”资产的投资比去年同期名义增长了12.2%。但这

跟钢铁和水泥产量出现的双位数降幅相矛盾。在楼盘销售、开工及拿地量下降的同时，显示房地产投资复苏的数据看起来也莫名其妙。一些地方政府表示国家统计局要求它们仔细复查数据，显然连官方统计人员都觉得那些官方数据不大对劲。

中国的高频指标在2020年春季时显现了自身价值。经济学家一开始不太敢下调增长预测。没有人确切知道经济会如何反应，也不知道国家统计局准备公布怎样的数据。有了来自高频数据的佐证，分析师们最终能够鼓足勇气预测2020年第一季度GDP将下降。事实上，最后连官方数据都显示GDP收缩了6.8%。

非常规指标的及时性让它们在变幻莫测的时期极具价值。然而，“这里面有许多陷阱”，陆挺说。任何短期数据都可能被恶劣天气或假期等因素扭曲。年增长率也可能被过去的特殊情况所歪曲。此外，某一周的公路货运指数大跌对季度GDP增长意味着什么？很难准确回答。许多这些指标推出的时间也不久。陆挺读博士时专攻计量经济学。“如果我运用在学校学到的那类计量方法去处理还只有一两年历史的数据，人们会笑话我的。”

为了避开一些陷阱，陆挺和他的团队会追踪“一组数字”。“如果十个指标中有七、八个在恶化，那么我们可以确信GDP增长正在恶化。”他说。至于现在，他认为，“肯定是出了什么大问题”。■



Free exchange

Will dollar dominance give way to a multipolar system of currencies?

Recent trends suggest the yuan will not gain much

IN THE WAKE of an invasion that drew international condemnation, Russian officials panicked that their dollar-denominated assets within America's reach were at risk of abrupt confiscation, sending them scrambling for alternatives. The invasion in question did not take place in 2022, or even 2014, but in 1956, when Soviet tanks rolled into Hungary. The event is often regarded as one of the factors that helped kick-start the eurodollar market—a network of dollar-denominated deposits held outside America and usually beyond the direct reach of its banking regulators.

The irony is that the desire to keep dollars outside America only reinforced the greenback's heft. As of September, banks based outside the country reported around \$17trn in dollar liabilities, twice as much as the equivalent for all the other currencies in the world combined. Although eurodollar deposits are beyond Uncle Sam's direct control, America can still block a target's access to the dollar system by making transacting with them illegal, as its latest measures against Russia have done.

This fresh outbreak of financial conflict has raised the question of whether the dollar's dominance has been tarnished, and whether a multipolar currency system will rise instead, with the Chinese yuan playing a bigger role. To understand what the future might look like, it is worth considering how the dollar's role has evolved over the past two decades. Its supremacy reflects more than the fact that America's economy is large and its government powerful. The liquidity, flexibility and the reliability of the system have helped, too, and are likely to help sustain its global role. In the few areas where the dollar has lost ground, the characteristics that made it king are still being sought out by holders and users—and do not favour the

yuan.

Eurodollar deposits illustrate the greenback's role as a global store of value. But that is not the only thing that makes the dollar a truly international currency. Its role as a unit of account, in the invoicing of the majority of global trade, may be its most overwhelming area of dominance. According to research published by the IMF in 2020, over half of non-American and non-EU exports are denominated in dollars. In Asian emerging markets and Latin America the share rises to roughly 75% and almost 100%, respectively. Barring a modest increase in euro invoicing by some European countries that are not part of the currency union, these figures have changed little in the past two decades.

Another pillar of the dollar's dominance is its role in cross-border payments, as a medium of exchange. A lack of natural liquidity for smaller currency pairs means that it often acts as a vehicle currency. A Uruguayan importer might pay a Bangladeshi exporter by changing her peso into dollars, and changing those dollars into taka, rather than converting the currencies directly.

So far there has been little shift away from the greenback: in February only one transaction in every five registered by the SWIFT messaging system did not have a dollar leg, a figure that has barely changed over the past half-decade. But a drift away is not impossible. Smaller currency pairs could become more liquid, reducing the need for an intermediary. Eswar Prasad of Cornell University argues convincingly that alternative payment networks, like China's Cross-Border Interbank Payment System, might undermine the greenback's role. He also suggests that greater use of digital currencies will eventually reduce the need for the dollar. Those developed by central banks in particular could facilitate a direct link between national payment systems.

Perhaps the best example in global finance of an area in which the dollar is genuinely and measurably losing ground is central banks' foreign-exchange reserves. Research published in March by Barry Eichengreen, an economic historian at the University of California, Berkeley, shows how the dollar's presence in central-bank reserves has declined. Its share slipped from 71% of global reserves in 1999 to 59% in 2021. The phenomenon is widespread across a variety of central banks, and cannot be explained away by movements in exchange rates.

The findings reveal something compelling about the dollar's new competitors. The greenback's lost share has largely translated into a bigger share for what Mr Eichengreen calls "non-traditional" reserve currencies. The yuan makes up only a quarter of this group's share in global reserves. The Australian and Canadian dollars, by comparison, account for 43% of it. And the currencies of Denmark, Norway, South Korea and Sweden make up another 23%. The things that unite those disparate smaller currencies are clear: all are floating and issued by countries with relatively or completely open capital accounts and governed by reliable political systems. The yuan, by contrast, ticks none of those boxes. "Every reserve currency in history has been a leading democracy with checks and balances," says Mr Eichengreen.

| *Battle royal*

Though the discussion of whether the dollar might be supplanted by the yuan captures the zeitgeist of great-power competition, the reality is more prosaic. Capital markets in countries with predictable legal systems and convertible currencies have deepened, and many offer better risk-adjusted returns than Treasuries. That has allowed reserve managers to diversify without compromising on the tenets that make reserve currencies dependable.

Mr Eichengreen's research also speaks to a plain truth with a broader

application: pure economic heft is not nearly enough to build an international currency system. Even where the dollar's dominance looks most like it is being chipped away, the appetite for the yuan to take even a modest share of its place looks limited. Whether the greenback retains its paramount role in the international monetary system or not, the holders and users of global currencies will continue to prize liquidity, flexibility and reliability. Not every currency can provide them. ■



自由交流

美元霸权会让位给多极货币体系吗？

近年趋势表明人民币难有大作为

在入侵行动招致国际谴责后，俄罗斯官员陷入了恐慌，担心他们在美国控制范围之内的美元计价资产会被突然没收，于是急忙寻找替代选择。这里说的入侵并非发生在2022年，甚至不是2014年，而是1956年，当时苏联坦克开进了匈牙利。该事件通常被认为是启动了欧洲美元市场的因素之一——这个市场是美国境外的一个美元存款网络，通常不受美国银行监管机构的直接管辖。

讽刺的是，把美元存放在美国之外的愿望反而强化了美元的影响力。截至去年9月，美国之外的银行报告的美元负债约为17万亿美元，是世界上所有其他货币负债总和的两倍。虽然欧洲美元存款不受山姆大叔的直接控制，但美国仍然可以立法禁止与某个国家交易，从而阻止该国使用美元体系，就像最近针对俄罗斯的制裁措施那样。

这最新爆发的金融战引出了一个问题：美元的主导地位是否已被削弱，一个多极货币体系是否将顺势崛起，由人民币在其中发挥更大的作用。要探究未来的可能面貌，有必要回顾过去二十年里美元角色的演变。美元的霸权地位不仅仅反映了美国经济体量的庞大和政府的强大。这个体系的流动性、灵活性和可靠性也是有利因素，并且很可能帮助它维持自身的全球地位。在少数几个美元已经失势的领域，货币的持有者和使用者仍然追捧这些让美元称霸的特征——而人民币在这些方面不占上风。

欧洲美元存款说明美元是一种重要的全球储值工具。但这并不是让美元成为真正的国际货币的唯一原因。大部分全球贸易在结账时都使用美元作记账单位，这可能才是它最具压倒性的优势。根据国际货币基金组织

（IMF）2020年发布的研究，超过一半的非美国和非欧盟出口是以美元计价的。在亚洲新兴市场和拉丁美洲，这一比例更是分别高达约75%和几乎100%。除了一些非欧元区欧洲国家小幅增加了欧元计价外，这些比例

在过去二十年几乎没有变化。

美元霸权的另一个支柱是作为跨境支付中的交换媒介。较小的货币对缺乏自然流动性，意味着美元经常充当周转货币。乌拉圭进口商给孟加拉出口商付款时，可能会先把比索兑换成美元，再把这些美元兑换成塔卡，而不是在两种货币间直接兑换。

到目前为止还没有什么从美元转移的趋势：今年2月，SWIFT报文系统登记的交易中只有五分之一不涉及美元计价，这个比例在过去五年里几无变化。但放弃美元也并非没有可能。较小的货币对可能会变得更有流动性，从而不再那么需要交换媒介。康奈尔大学的埃斯瓦尔·普拉萨德（Eswar Prasad）令人信服地指出，中国的跨境银行间支付系统等替代支付网络可能会削弱美元的地位。他还表示，扩大使用数字货币最终将减少对美元的需求。特别是由央行开发的数字货币，将可以促进各国支付系统之间的直联。

要说全球金融中有哪个环节最能显现美元正在切实且显著地失势，那可能是各国央行的外汇储备。加州大学伯克利分校的经济史学家巴里·艾肯格林（Barry Eichengreen）3月发表的研究显示，美元在央行储备中的比重已经下降。其占全球储备的份额从1999年的71%降至2021年的59%。这一现象遍及形形色色的央行，且无法用汇率变动来解释。

研究结果揭示出美元的新竞争对手一些令人瞩目的特征。很大程度上，美元的份额丢失转化成了艾肯格林所称“非传统储备货币”的份额增加。在这组货币的全球储备占比之中，人民币仅占四分之一。相比之下，澳元和加元占到43%。而丹麦、挪威、韩国和瑞典的货币占了23%。这些五花八门的小货币具有显而易见的共同点：都是浮动汇率，由资本账户相对或完全开放的国家发行，并由可靠的政治体系治理。对比之下，人民币并不符合上述任何特征。“历史上每一种储备货币都来自带有制衡机制的领先民主政体。”艾肯格林表示。

| 王位之战

虽然美元会否被人民币取代的讨论体现了大国竞争的时代氛围，现实实则更平淡无奇。在拥有可预测的法律体系以及可兑换货币的国家，资本市场已经深化发展，其中许多都能提供比美国国债更高的风险调整后收益。这使得外汇储备的管理者可以实现多元化却不必在令储备货币稳定可靠的那些原则上妥协。

艾肯格林的研究还揭示了一个适用于很多方面的浅显道理：单纯依靠经济影响力远远不足以建立起一个国际货币体系。即使在美元霸权看起来最像是在被削弱的领域，对于让人民币来分走它的哪怕不大的一块地盘的偏好看来也有限。无论美元是否保有它在国际货币体系中至高无上的地位，全球货币的持有者和使用者仍将看重流动性、灵活性和可靠性。不是每种货币都具备这些特点。 ■



A tale of two surges

Asia's outbreaks show that Omicron is deadly in unvaccinated people

Covid has never spread faster than in recent surges in Hong Kong and South Korea

DURING THE first two years of the covid-19 pandemic, rich Asian countries had lower case rates than almost anywhere else. But like a dam holding back a flood, the longer a region's defences hold up, the worse the resulting disaster once they fail.

The Omicron variant has swept remarkably fast through places with little past exposure to covid. As a share of population, South Korea has logged more cases in 2022 than America has during the entire pandemic. Hong Kong's surge has been even more abrupt. Until this February, it barely had any positive tests. Its cumulative caseload per person now matches Finland's.

In Europe Omicron has caused greater increases in cases than in hospitalisations or deaths. Two factors have combined to yield such mild disease: strong immunity levels and Omicron's low severity when compared with Delta. Until recently, it was unclear which mattered more. But the Asian data show that immunity is crucial, and that Omicron is still deadly for unvaccinated people who have not yet had covid.

Hong Kong and South Korea provide a natural experiment. Both were mostly covid-free before 2022, and had little infection-induced immunity. But South Korea has had a strong vaccine roll-out, whereas Hong Kong has had one of the rich world's worst. Its messaging was decidedly mixed, giving equal weight to arguments for and against vaccination, and telling people with chronic diseases to consult doctors before getting jabs. Its nurses worried about personal liability for mishaps.

Hong Kong also made heavy use of Sinovac, a Chinese vaccine that is less effective than Western shots. According to Ming Pao, a newspaper, of Hong Kongers who died in the recent wave, 71% were unvaccinated and another 25% had received Sinovac. Just 4% got Western vaccines.

Unfortunately, Hong Kong's elderly were unusually hesitant. In South Korea take-up of booster shots, which are needed to protect against Omicron, is greatest among the old. In Hong Kong, in contrast, those most likely to get boosted are middle-aged. Just 37% of its septuagenarians and 14% of those 80 or older, the most vulnerable groups, are boosted—similar to the shares among people aged 20-39 and teenagers, respectively. When Omicron first struck, these rates were even lower.

This discrepancy has had a big impact. During the Omicron wave, Hong Kong's official covid mortality rate has been five times higher than South Korea's. These figures can be biased by differences in testing rates and judgments on causes of death. But fair comparisons can be made with excess mortality—the gap between the number of deaths from all causes and the number expected under normal conditions.

Although recent total-mortality numbers have not been published, our best estimate suggests that since February 1st 2.4 times as many people have died because of the pandemic in Hong Kong as in South Korea. At the peak of Hong Kong's surge in early March, its daily excess-death rate was between those registered in London (1.8 per 100,000 people) and New York (5.1) when covid first struck—a period with no vaccines, little testing and an incorrect understanding of how the virus spreads.

Sources: Our World in Data; Public Health England; CDC; Korea Disease Control and Prevention Agency; Hong Kong Department of Health; The Economist ■



双城疫

亚洲近期的疫情表明，奥密克戎对未接种者很致命

在香港和韩国的新一波疫情中，新冠病毒以空前高速传播

在新冠病毒肆虐全球的头两年，富裕亚洲国家和地区的感染率几乎比任何地方都低。但是，就像用堤坝阻挡洪水一样，一个地方的防御撑得越久，一旦失守所造成的灾难就越严重。

奥密克戎毒株以惊人的速度席卷之前新冠病毒少有传播的地方。按病例占人口的比例计算，韩国在2022年的数字比美国在整个疫情期间的数字还要高。香港此轮爆发更是迅猛。在今年2月以前香港几乎没多少检测阳性的病例，但现在人均累计病例数已与芬兰相当。

在欧洲，奥密克戎毒株造成的病例数字增幅大于住院或死亡人数的增幅。新冠病情变得如此温和是因为两个因素的综合作用：人群免疫水平高，奥密克戎的毒性低于德尔塔。直到最近，人们还不清楚哪个因素更为关键。但如今亚洲的数据显示，免疫力至关重要，对没有新冠感染史又尚未接种疫苗的人而言，奥密克戎依然致命。

香港和韩国提供了一场自然实验。两地在2022年之前都没有太多病例，也就没有多少因感染而获得的免疫力。但韩国的疫苗接种率高，而香港则是富裕世界里接种率最低的地区之一。香港的宣传信息明显混乱，支持和反对接种疫苗的论调并行，又提醒慢性病患者在接种疫苗前要先咨询医生的意见。香港的护士担心遇意外或不幸需要个人担责。

而且，香港有不少人接种了科兴疫苗，这是中国研发的一款疫苗，防护效果不如西方疫苗。据《明报》报道，香港最近这波疫情的死亡病例中，71%未接种疫苗，25%接种了科兴疫苗，只有4%接种了西方疫苗。

遗憾的是，香港老年人对于接种疫苗异常迟疑。抵御奥密克戎需要接种加强针，在韩国，老年人接种加强针的比例最高。相比之下，在香港是中年

人最高。只有37%的七旬老人和14%的八旬或以上老人（两个最高危群体）接种了加强针，分别与20岁至39岁人群及青少年人群的接种比例相当。奥密克戎最初来袭时，这些比例还要更低。

这种差异影响很大。在这波奥密克戎疫情期间，香港官方公布的新冠死亡率是韩国的五倍。这些数字可能因为检测率和对死亡原因判定的不同而有所偏差。但可以通过“超额死亡率”做公平的比较，即因各种原因实际死亡的人数与正常情况下的预计死亡人数之间的差距。

虽然近期的总死亡人数尚未公布，但我们的最佳估计值表明，自2月1日以来，香港死于新冠病毒的人数是韩国的2.4倍。在3月初香港疫情的最高峰期，每日的超额死亡率介于新冠疫情最初爆发时的伦敦（每十万人中有1.8人）和纽约（每十万人中有5.1人）之间，当时还没有疫苗，检测也少，对病毒的传播机制还存在误解。

资料来源：Our World in Data；英格兰公共卫生署；美国疾病控制与预防中心；韩国疾病管理厅；香港卫生署；《经济学人》 ■



Diversionsary tactics

What can Russia do to sell its unwanted oil?

China and India sniff a bargain

ON FEBRUARY 22ND, two days before Russia invaded Ukraine, a German-flagged vessel left the Russian port of Primorsk loaded with 33,000 tonnes of oil. When it reached Tranmere, a British oil terminal, on March 3rd, it received a frosty welcome. Some dockers refused to unload the freight when they learnt where it had come from. Similar boycotts have sprung up elsewhere. Kayrros, a data firm, estimates that the volume of oil “on water” rose by nearly 13% in the fortnight after the invasion, in large part as undelivered Russian cargo sought new takers. The number of vessels returning to Russia also jumped.

Most of what has flowed out of Russia in recent weeks was bought and paid for before the war started. Now less oil is leaving the country in the first place. Worries about sanctions and bad publicity have prompted many buyers to pause purchases. On March 24th the volume of Russian seaborne oil exports, at 2.3m barrels per day (bpd), was nearly 2m below the level on March 1st, reckons Kpler, a data firm. As those barrels fail to sell, the price of Brent crude is nearing \$115. Yet for the countries willing to risk opprobrium and jump through new logistical hoops, Russian oil is beginning to look like a bargain.

The partial embargo of Russia has echoes with the blockade of Iran by the West in the 2010s, which led the Islamic Republic to put together an unrivalled playbook for smuggling oil. In May 2018 America imposed “maximum pressure” sanctions, with the aim of halting Iran’s oil exports altogether. It almost succeeded: by October 2019 they had fallen to an average of 260,000 bpd, from 2.3m before the sanctions. Since then, however, they have revived a little, averaging 850,000 bpd in the three

months to February 2022.

Iran manages to sell oil through two channels. The first is through authorised but restricted sales. As it imposed its sanctions America granted a limited exemption to eight importing countries. There is a big catch, however: the sales have to be made in the buyers' currency and either kept in escrow accounts at local banks or spent on a list of goods produced locally. For Iran that is deeply frustrating. In December it was forced to accept tea from Sri Lanka as payment for an oil debt valued at \$251m.

To circumvent the restrictions Iran smuggles vast quantities of oil—its second channel for sales. Iranian tankers sail to America's foes, such as Venezuela, with their transponders turned off. Some are repainted to hide their provenance. Others transfer their cargo in the high seas, often at night, to ships sailing under a different flag. Oil is also moved over land by smuggling gangs, says Julia Friedlander, a former intelligence official now at the Atlantic Council, a think-tank in Washington. Petroleum is bartered with China, Turkey and the United Arab Emirates against gold, pesticides and even housing projects in Tehran. Traders in Dubai, home to half a million Iranians, blend crude from the Islamic Republic with other, similar grades which they then rebrand as Kuwaiti oil.

Russia is unlikely to take a leaf out of Iran's book, mainly because, for now, it doesn't need to. The penalties imposed on Iran include secondary sanctions that threaten third-country banks dealing with it with huge fines. That makes overtly buying its oil risky. By contrast, Russia faces a weaker embargo. Only America, which did not buy much to begin with, has banned its oil. On March 25th Germany said it would cut its purchases by half, but it is unclear when that would start. Sales transmitted through pipelines, which are less conspicuous than shipments and represent about a fifth of Russia's total exports of crude, are still flowing. Secondary sanctions have not been imposed.

Instead seaborne exports have cratered because Western buyers, such as big energy firms, fear a public backlash. They also face logistical headaches as cautious banks cut credit, ship owners struggle to obtain insurance and freight costs soar. And each time sanctions are tweaked, says Antonia Tzinova of Holland & Knight, a law firm, compliance staff must study hundreds of pages of legalese, making many Russian deals hardly worth the hassle. As a result, Urals crude, the grade pumped out by Russia, is currently trading at a discount of around \$31 a barrel. One trader expects the gap to hit \$40 within a week's time.

Two big countries that have not joined in with the West's sanctions—India and China—sense a bargain to be had. India is certainly acting on the opportunity. Russian ship loadings headed for the subcontinent are expected to have risen to 230,000 bpd in March, up from nothing in the previous three months (this excludes CPC, a blend of mainly Kazakh and Russian crude). Yet India is unlikely to buy much, at least in the short term. Nearly half its imports come from the Middle East, and shipping from the Gulf is much cheaper than shipping from Russia. Payment cannot be settled in dollars, requiring India to experiment with a rouble-rupee mechanism.

Adi Imsirovic, a former oil-trading boss of Gazprom now at the Oxford Institute of Energy Studies, does not see India buying more than 10m barrels a month. This is small, considering that Russia's pool of unwanted oil is expected by the International Energy Agency, an official forecaster, to reach 3m bpd in April.

Only China, then, can save Russia. It imports a total of about 10.5m bpd (11% of the world's daily production). Mr Imsirovic thinks China could opportunistically increase its purchases to 12m bpd. That could allow it to buy 6m from Russia in relatively short order. It helps that China has lots of empty storage.

None of this is happening yet. Even for China, transporting oil from Russia has become harder. Whereas shipment from Russia to Europe usually takes three or four days, to Asia it takes 40. Oil must be loaded onto bigger tankers, which is slow and costly. Chinese banks are loth to lend.

Payment is another problem. Financiers in Hong Kong, who have ample access to greenbacks, have helped North Korea receive hard currency in the past. But Russia's energy deals would be far too large to hide in the city's financial system, says a trade lawyer. And its main regulator would not turn a blind eye to such dealings, lest they lead America to suspend Hong Kong's ability to clear dollars locally, a privilege central to its economy.

One fix, however, is for Russia to use Chinese bank accounts within China to receive payment in yuan. Those accounts could then be used to finance imports of essential goods, avoiding the cross-border dimension of trade accounting.

China may also be biding its time. Even with the extra costs, buying Russian oil would save lots of money. And Chinese traders know a bargain when they see one: when the oil price neared single digits during the covid-induced downturn of 2020, they stocked up to the gills. As Russia's trading position weakens, the Urals discount will go up. So will China's purchases.

Such a move will not be easily reversed. Most refineries are configured to guzzle certain types of crude, meaning switching from the high-sulphur Urals variety to, say, Saudi Arabia's super light takes time and money. That in turn suggests Russia's push into Asia and Europe's scramble for supplies could reshape the global market. Much of North Sea oil usually goes east; more of it might now stay in Europe. The continent will probably also buy more from West Africa and America, and crank up its imports of sulphur-rich grades from the Gulf. The rest of the world—Asia included—will have to content itself with what Europe does not want. Oil from the Tupi field in

Brazil already trades at twice the premium to Brent than usual.

The result of this more fragmented global oil-trading system will be a structurally higher price for importers. Until the war petroleum generally flowed seamlessly from oilfields to the fuel tanks that needed it most. Now, says Ben Luckock of Trafigura, a trading firm, that finely tuned system has been disrupted. ■



暗度陈仓

俄罗斯怎样才能卖出滞销的石油？

中国和印度嗅到了捡便宜的机会

二月二十二日，也就是俄罗斯入侵乌克兰的两天前，一艘悬挂德国国旗的船舶驶离俄罗斯港口普里莫尔斯克（Primorsk），船上装载着3.3万吨石油。3月3日，它抵达英国的石油码头特兰米尔（Tranmere），但受到了冷遇。一些码头工人在得知货物的来源地之后拒绝卸货。类似的抵制很快也在其他地方涌现。据数据公司Kayrros估计，俄罗斯发起入侵行动后的两周内，“漂在海上”的石油数量增加了近13%，这主要是因为没能交付的俄罗斯石油在寻找新买家。返回俄罗斯的船舶数量也大幅增加。

最近几周从俄罗斯运出的石油大部分都是在战争开始前购买和付款的。现在，运离俄罗斯的石油也已经减少了。由于担心被制裁和引来负面宣传，许多买家暂停购买俄罗斯石油。据数据公司Kpler估计，3月24日，俄罗斯通过海运出口的石油为每天230万桶，比3月1日减少了近200万桶。由于那些没能卖出的部分，布伦特原油价格正逼近每桶115美元。然而，对于那些愿意冒被世人谴责的风险并杀出一条物流通路的国家来说，俄罗斯的石油开始显得很划算。

对俄罗斯实施的部分禁运与2010年代西方对伊朗的封锁相似，而封锁之下的伊朗为走私石油发展出了一套无可匹敌的战术手册。2018年5月，美国对伊朗实施了旨在完全停止其石油出口的“极限施压”制裁。美国的目的基本达成：截至2019年10月，伊朗的石油出口量从制裁前的每天230万桶降至平均每天26万桶。不过，自那以后出口略有回升，在去年12月到今年2月的这三个月里，出口量为每天85万桶。

伊朗通过两大渠道设法出售石油。一是通过经批准但有限制的销售。在对伊朗实施制裁的同时，美国给予了八个国家和地区有限的进口豁免。不过这当中有个“大坑”：交易必须以买方货币结算，并且结算款要么存入当地银行的第三方保管账户，要么用于购买指定的当地生产的商品。这让伊朗

非常懊恼。去年12月，它被迫接受来自斯里兰卡的茶叶，用于支付价值2.51亿美元的石油款。

为规避各种限制，伊朗大量走私石油——它的第二个销售渠道。关闭了应答器的伊朗油轮驶往委内瑞拉等美国的对头国家。这些油轮有的被重新刷漆，以隐瞒来源地。有的则在公海上——通常是在夜间——把石油转运到悬挂着别国国旗的船舶上。曾担任过情报官员、现就职于华盛顿的智库大西洋理事会（Atlantic Council）的朱莉娅·弗里德兰德（Julia Friedlander）表示，走私团伙也通过陆路运输石油。伊朗用石油换取中国、土耳其和阿联酋的黄金、农药，甚至还有德黑兰的住房开发项目。在有50万伊朗人居留的迪拜，贸易商把伊朗原油与其他类似品级的原油混合，然后打上科威特石油的标签。

俄罗斯不太可能学伊朗的招数，这主要是因为就目前而言它还不需要这样做。对伊朗实施的制裁包括二级制裁，也就是与伊朗打交道的第三国银行都有可能受到巨额罚款。这使得公开购买伊朗石油的风险很大。相比之下，俄罗斯遭遇的禁运没那么严厉。只有美国禁止进口俄罗斯石油，而美国本来也没买多少。3月25日，德国表示将把进口量减半，但尚不清楚何时开始实施。管道输送原油不像船运那么引人注目，这部分约占俄罗斯原油出口的五分之一，眼下仍未中断。迄今还没有实施二级制裁。

由于大型能源公司等西方买家担心被公众抵制，反倒是海运石油出口遭受了重创。海运在物流方面也面临难题：银行出于谨慎削减了信贷，船主难以获得保险，运费也在飙升。律师事务所Holland & Knight的安东尼娅·齐诺娃（Antonia Tzinova）表示，制裁措施一有调整，合规人员就必须研读数百页的法律文件，如此费劲使得与俄罗斯的许多交易变得不值得。结果就是俄罗斯出产的乌拉尔原油目前以每桶便宜约31美元的折扣价交易。一位交易员预计一周内这一折扣将达到40美元。

印度和中国这两个没有加入西方制裁的大国察觉到便宜可捡。印度无疑正在利用这个机会。3月，运往印度的俄罗斯海运原油估计达到每天23万桶，而在此之前的三个月里这一数字还是零（不包括主要由哈萨克和俄罗

斯原油混合而成的CPC混合油)。不过印度不太可能购买太多，至少短期内是这样。印度近一半的石油来自中东，而且从海湾地区运油比从俄罗斯便宜得多。支付不能用美元结算，这就使得印度必须尝试卢布兑卢比的机制。

曾在俄罗斯天然气工业股份公司（Gazprom）负责石油贸易、现任职于牛津能源研究所（Oxford Institute of Energy Studies）的阿迪·伊姆西洛维奇（Adi Imsirovic）认为，印度的月进口量不会超过1000万桶。这是个小数目，因为根据官方预测机构国际能源署（IEA）的预计，俄罗斯4月每天卖不掉的石油将达到300万桶。

那么，能拯救俄罗斯的只有中国了。中国日石油进口总量约为1050万桶（占全球日产量的11%）。伊姆西洛维奇认为，中国可能会抓住这个机会，将石油进口量增加到每天1200万桶。这可能会让它在相对较短的时间里从俄罗斯购买6000万桶石油。中国有大量空置的储存设施，这是一个有利条件。

不过这一切都尚未发生。即使对中国而言，从俄罗斯运输石油也变得更难了。从俄罗斯运到欧洲通常花三到四天，到亚洲要40天。装运石油必须使用大型油轮，速度慢，成本又高。并且中国的银行很不乐意为此放贷。

支付也是个问题。香港的金融机构有充足的渠道获取美元，以前它们曾帮助朝鲜获得硬通货。但一位贸易律师表示，俄罗斯能源交易的规模太大，无法在香港的金融体系中瞒天过海。香港的主要监管机构不会对这类交易视而不见，以免被美国暂停其本地结算美元的权限，而这一特殊待遇对香港的经济至关重要。

不过，对俄罗斯来说有一个权宜之计，那就是用中国境内的中资银行账户接收人民币付款。到时候这些账户可以用来为进口必需品提供资金，这就避免了贸易核算中的跨境问题。

中国可能也在伺机而动。即使加上额外的成本，购买俄罗斯石油也还是能省很多钱。而中国贸易商在捡便宜方面一向非常精明：2020年，新冠疫情

导致经济低迷，油价接近个位数，他们在那时囤积了大量石油。如今俄罗斯的交易地位削弱，乌拉尔原油的折扣力度会加大。中国的购买量也会随之增加。

走出这样一步将不会被轻易逆转。大多数炼油厂的设备都是为大量加工某些种类的原油而配置的，也就是说，如果炼油厂放弃高硫的乌拉尔原油，而改用超轻质的沙特原油的话，就要又花时间又花钱。这进而表明，俄罗斯石油进入亚洲以及欧洲争夺稀缺的供应可能会重塑全球石油市场。大部分北海石油通常运往东方，现在它们可能会更多地留在欧洲。欧洲可能还会从西非和美国买入更多，并加大进口海湾地区的高硫原油。包括亚洲在内的世界其他地方只能将就购买欧洲不想要的油。巴西图皮油田（Tupi）的原油对布伦特原油的交易溢价已经较平常翻番。

全球石油贸易体系更加碎片化会给进口国带来结构性的价格上涨。在俄乌战争之前，石油基本都畅通无阻地从油田流向最需要它的油箱。现在，贸易公司托克（Trafigura）的本·拉科克（Ben Luckock）说，这个精心调优的系统已经被打乱了。■



Surge pricing

How companies use AI to set prices

The pricing of products is turning from art into science

FEW AMERICAN business tactics are as peculiar in a freewheeling capitalist society as the manufacturer's suggested retail price. P.H. Hanes, founder of the textile mill that would eventually become HanesBrands, came up with it in the 1920s. That allowed him to use adverts in publications across America to deter distributors from gouging buyers of his knitted under garments. Even today many American shopkeepers hew to manufacturers' recommended prices, as much as they would love to raise them to offset the inflationary pressures on their other costs. A growing number, though, resort to more sophisticated pricing techniques.

A seminal study from 2010 by McKinsey, a consultancy, estimated that raising prices by 1% without losing sales can boost operating profits by 8.7%, on average. Getting this right can be tricky. Set prices too high and you risk losing customers; set them too low and you leave money on the table. Retailers have historically used rules of thumb, such as adding a fixed margin on top of costs or matching what competitors charge. As energy, labour and other inputs go through the roof, they can no longer afford to treat pricing as an afterthought.

To gain an edge, shopkeepers have been turning to price-optimisation systems. These predict how customers will respond to different pricing scenarios, and recommend those that maximise sales or profits. At their core are mathematical models that use oodles of transaction data to estimate price elasticities—how much demand increases as the price falls and vice versa—for thousands of products. Price-sensitive items can then be discounted and price-insensitive ones marked up. Merchants can fine-tune the algorithms to prevent undesirable outcomes, such as double-digit

price surges or larger packages costing more by unit of weight than smaller ones.

These systems are becoming cleverer thanks to advances in artificial intelligence (AI). Whereas older models used historical sales data to estimate price elasticities for individual items, the latest crop of AI-powered ones can spot patterns and relationships between multiple items. Makers of pricing software are incorporating new data sources into their models, from customers' tweets to online product reviews, says Doug Fuehne of Pricefx, one such firm. The cloud-based platform developed by Eversight, another provider, allows retailers to test how slight increases or decreases in the price of, say, Heinz ketchup at different stores affect sales not just of that specific condiment but across the category. It is used by big manufacturers such as Coca-Cola and Johnson & Johnson, as well as some supermarkets (Raley's) and clothes-sellers (JCPenney).

All this makes pricing systems "much more three-dimensional", observes Chad Yoes, a former executive at Walmart who oversaw pricing at the retail behemoth. Retail bosses are keen to promote this sophistication to investors, who value firms' pricing power at a time of high inflation. In February Starbucks, a chain of coffee shops, boasted about its use of analytics and AI to model pricing "on an ongoing basis". US Foods, a food distributor, has touted its pricing system's ability to use "over a dozen different inputs" to boost sales and profits.

Price-optimisation may make prices more volatile. "Retailers are pricing faster today than they ever have before," says Matt Pavich of Revionics, another pricing-software firm. That is especially true in the fast-moving world of e-commerce. But even Walmart reviews the prices of many items in its stores 2-4 times a year, says Mr Yoes, up from once or twice a few years ago.

What pricing systems do not do is lead inexorably to higher prices. Mr Pavich calls this misconception “one of the biggest myths” about products like his. Sysco, a big food distributor which rolled out new pricing software last year, is a case in point. The firm says the system allows it to lower prices on “key value items”—as price-sensitive bestsellers are known in the trade—and raise them on other products. It can thus increase profits by expanding sales while maintaining margins. That keeps investors content and shoppers sweet. ■



动态定价

公司如何用AI定价

产品的定价正从技巧转为科学

在美国这个自由放任的资本主义社会，很少有商业策略像“制造商建议零售价”那般古怪突兀。这个定价机制是P.H.哈内斯（P.H. Hanes）上世纪20年代提出的，他创建的纺织厂最终发展成了汉佰百货（HanesBrands）。他在美国各地的出版物上刊登建议零售价的广告，防止经销商对购买他的针织内衣的买家漫天要价。即使在今天，许多美国店家仍然坚守制造商建议的价格，尽管他们也很想抬价以抵消通胀带来的其他成本压力。不过，越来越多的公司正诉诸于更复杂的定价方式。

咨询公司麦肯锡在2010年开展的一项开创性研究估计，在不损失销售额的情况下，每提价1%平均可以让营业利润提升8.7%。要把握好这个度会很难。定价过高，可能会失去顾客；定价太低，就得不到应得的最大利益。零售商历来都采用经验法则，比如在成本之上加上固定的利润额，或者跟上竞争对手的开价。随着能源、劳动力和其他投入的价格飞涨，它们已经承担不起把定价放到后头考虑了。

为能驾驭局面，零售商们已经转而使用价格优化系统。这些系统预测顾客对不同定价方案的反应，推荐那些让销售额或利润最大化的方案。系统的核心是利用大量交易数据来评估成千上万种产品价格弹性的数学模型。所谓价格弹性，就是随着价格的升降，需求增加或减少的程度。然后对价格敏感的商品可以打折，对价格不敏感的商品可以加价。商家可以微调算法以避免不合理的后果，比如两位数的大涨价，或者大包装的重量单价反而高于小包装。

随着人工智能（AI）的进步，这些系统正变得愈发聪明。旧的模型用历史销售数据估算单个商品的价格弹性，而最新一代AI模型可以发现多个商品之间的模式和关系。定价软件的开发者正在把顾客的推文和网上产品评价等新的数据源整合进自己的模型中，道格·福涅（Doug Fuehne）表示。

他就职的软件公司Pricefx就是其一。另一家软件公司Everight开发了基于云计算的平台，可以让零售商测试一种商品价格的小幅上调或下调——比如对不同商店里的亨氏番茄酱调价——会如何影响该商品的销量，乃至整个品类的销量。使用这一平台的有可口可乐、强生等大型制造商，也有一些超市（Raley's）和服装卖场（JCPenney）。

所有这些都让定价系统变得“立体得多了”，曾在零售巨头沃尔玛负责定价的前高管查德·尤斯（Chad Yoes）表示。零售业的老板们热衷于向投资者宣传这类复杂精密的系统，因为投资者在高通胀时期看重公司的定价能力。今年2月，连锁咖啡店星巴克声称自己利用分析技术和AI为定价“实时”建模。食品分销商美国食品（US Foods）自诩其定价系统能够运用“十几种不同的输入数据”提升销售额和利润。

价格优化可能会让价格更不稳定。另一家定价软件公司Revonics的马特·帕维奇（Matt Pavich）说：“现在零售商定价比以往任何时候都要快。”在瞬息万变的电子商务世界尤其如此。但尤斯表示，就算是沃尔玛，每年也会对店内许多商品的价格做二到四次评估，而几年前只做一两次。

定价系统并不是让价格只涨不跌。帕维奇称这种误解是对像他的这类产品“最大的谬见之一”。去年应用了新定价软件的大型食品分销商Sysco就是一个很好的例子。该公司表示，该系统让它能够降低“关键价值商品”（业内对价格敏感畅销品的称法）的价格，并提高其他产品的价格。这样一来可以扩大销售而不损害利润空间，从而增加盈利。这既让投资者满意，也讨好了顾客。■



Buttonwood

Can the Fed pull off an “immaculate disinflation”?

Past experience suggests soft landings are hard to pull off

FIGHTING INFLATION gets harder the longer it is put off—and the Federal Reserve has waited quite a while. For most of 2021 the central bank said that it had the tools to slow price rises, but saw no need to put them to use. Now investors are coming to terms with the fact that the Fed will have to deploy them at scale. Since March 1st the three-year Treasury yield has risen by more than a percentage point, the biggest absolute change since yields collapsed in January 2008 during the global financial crisis.

The move reflects the emergence of expectations that the Fed will increase interest rates by another two percentage points this year, having already raised them by a quarter of a point on March 16th. The impact has been felt worldwide. On March 28th the Bank of Japan promised to buy Japanese government debt in unlimited quantities over four days in order to defend its cap on the ten-year government-bond yield. The yield on ten-year German bunds, which turned positive only in January, now stands at over 0.6%, even as soaring energy prices darken the growth outlook.

The most important question for bond investors in America is whether the higher interest rates that are arriving hard and fast can bring about a fabled “soft landing”, in which the heat is taken out of the economy without provoking a recession. Past experience suggests that this will be difficult; tightening has often preceded downturns. Jerome Powell, the Fed’s chairman, has pointed to successful soft landings in 1964, 1984 and 1993. But those comparisons do not account for the difficulty of the present situation. In none of those cases did the Fed let inflation rise as far as it has today.

The central bank's latest projections are rosy, portraying what its critics have dubbed an "immaculate disinflation": three years of steadily falling inflation, despite GDP growth remaining above its long-run trend and both the unemployment rate and the Fed's policy rate remaining unusually low. Mr Powell may have given up calling inflation "transitory", but these forecasts make sense only if inflation goes away of its own accord.

It seems likelier that the central bank will have to squeeze inflation out of the economy. Noting that there is no precedent for doing so gracefully, Bill Dudley, a former head of the New York Fed, wrote in a Bloomberg column on March 29th that a recession was now inevitable. The r-word is also in the air because yields on some short-term bonds have risen above those on longer-term bonds. Such a yield-curve "inversion" suggests that investors expect interest rates to be cut eventually as the economy weakens.

An inverted yield curve is often regarded as a sign that markets think the central bank is making a mistake. The uncomfortable truth, however, is that a recession and a mistake are not the same thing if causing a downturn is the only way to restore price stability. In the 1980s Paul Volcker's Fed vanquished inflation by inducing recessions that pushed the unemployment rate to 10.8%. Nobody accuses it of having done so inadvertently; rather, it chose to pay the high price of disinflation. That is not a position in which today's central bankers want to be; they talk as much about their duty to support jobs and growth as they do about ensuring stable prices.

The good news for Mr Powell is that for all the chatter about the yield curve, investors remain mostly on his side. Most economists put the neutral level of interest rates, at which monetary policy is pressing on neither the accelerator nor the brake, at around 2-2.5%. Both the Fed and the bond market expect the policy rate to overshoot that level only slightly. Rates a notch or two above neutral can hardly be compared with Volcker's

tightening. The market expects immaculacy, too, believing that modestly tight money will be enough to control inflation.

The recent predictive record of both central bankers and bond markets has been poor, however. Just a year ago the Fed's message was that it was not even "talking about talking about" tightening monetary policy, and investors expected consumer prices to rise by just 2.7% over the following year. If they are caught out again, the Fed could find that meeting its inflation target demands that it induce a recession. The yield curve would then invert more steeply.

In that scenario America would pay a dear price for the glacial pace of action in 2021, which was justified, ironically, by the supposed dangers of sudden moves. It has left the central bank, the world economy and asset prices on more perilous ground. ■



梧桐

美联储“完美反通胀”胜算几何？

过往经验表明软着陆难以实现

拖延越久，通胀就越难克服——而美联储已经等待了相当长的时间。在2021年大部分时间里，美联储声称掌握着减缓价格上涨的工具，但认为没有必要出手。现在，投资者开始接受这样一个事实：美联储将被迫大规模部署这些工具。自3月1日以来，三年期美国国债收益率已经上升超过一个百分点，这是自2008年1月全球金融危机期间收益率暴跌以来最大的绝对值变动。

收益率飙升反映了市场开始预期美联储今年还将再加息两个百分点，此前美联储在3月16日已经加息0.25个百分点。全世界都受到了震动。3月28日，日本央行承诺连续四天无限量购买国债，以防止其10年期国债收益率升破目标上限。10年期德国国债收益率在1月才刚刚转为正值，现在已经超过0.6%，与此同时，能源价格高涨为增长前景蒙上了阴影。

对于美国的债券投资者来说，最重要的问题是逃不掉的加息能否带来传说中的“软着陆”，即在不引发经济衰退的情况下给经济降温。过往经验表明这很难：紧缩政策往往伴随着经济衰退。美联储主席鲍威尔指出1964年、1984年和1993年均有成功软着陆的先例。但考虑到当前的困境，这并不完全具有可比性。在这几个例子里，美联储都没有放任通胀上升到今天的程度。

美联储最近给出的预测十分乐观，描绘了一幅被评论家称为“完美反通胀”的景象：通胀率将在三年里稳步下降，而GDP增速将维持在长期趋势之上，失业率和美联储政策利率也都将保持在异常低的水平。鲍威尔可能已放弃了“暂时性”通胀的提法，但只有当通胀自行消失，这些预测才说得通。

看起来更有可能的是，美联储将不得不从经济中挤掉通胀。纽约联储前主

席比尔·达德利（Bill Dudley）指出，并没有优雅地做这件事的先例。3月29日他在彭博一个专栏上撰文称经济衰退已不可避免。一些短期债券的收益率已经高于长期债券，经济衰退的言论正在流传。这种收益率曲线“倒挂”表明投资者预计随着经济走弱，利率终将下调。

收益率曲线倒挂通常被视为一种信号：市场认为美联储正在犯下错误。然而，有一个令人不快的事实，那就是如果让经济下行是恢复价格稳定的唯一途径，那么衰退并不等同于错误。1980年代，沃尔克领导下的美联储诱导了经济衰退，将失业率推高至10.8%，从而消除了通胀。没有人指责这是一个过失，相反，这是美联储为了反通胀而主动选择付出的高昂代价。但这并不是今天美联储官员的立场：他们誓言确保物价稳定，同时又大谈自己支撑就业和经济增长的责任。

对鲍威尔来说，好消息是尽管市场对收益率曲线议论纷纷，但投资者基本上仍然站在他这一边。大多数经济学家认为中性利率（即货币政策既不踩油门也不踩刹车的水平）在2%到2.5%左右。美联储和债券市场都预计政策利率只会略高于这一水平。如果利率只是比中性水平高出一两档，那根本不能和沃尔克的紧缩政策相提并论。市场也憧憬着完美的结果，认为适度紧缩的货币政策将足以控制通胀。

然而，美联储官员和债券市场最近的预测记录实在不敢恭维。就在一年前，美联储还表示尚未“开始讨论是否要讨论”收紧货币政策，而投资者则预测下一年的消费物价只会上涨2.7%。如果他们再次猜错，美联储可能会发现，要达到通胀目标就必须引发衰退。到那时，收益率曲线将倒挂得更加严重。

到了那种情形下，美国将为2021年的龟速行动付出高昂代价。讽刺的是，由于假定突然采取动作有危险，这种迟缓被认为是合理的应对。而这已经把美联储、世界经济和资产价格置于更加危险的境地。■



The Economist Film

NFTs - Are they worth the hype? Part 1

It took seven years for NFTs to hit the mainstream. In 2020, around 150000 NFTs were sold on OpenSea, one of the biggest NFT trading platforms. In 2021 more than four times that were being sold monthly. A few things drove that boom.



经济学人视频

NFT热潮是泡沫吗？（上）

NFT用了七年时间成为主流。2020年在最大交易平台之一的OpenSea上，卖出了约15万个NFT。到2021年，每月成交量即达到这个数字的四倍。这波繁荣有几个推手。



Keep it in the family

The Sassoons were once Asia's top business dynasty

"The Global Merchants" tells the story of their rise and fall

The Global Merchants. By Joseph Sassoon. Allen Lane; 412 pages; £30

BEYOND THE crumbling fish dock in Mumbai or on Shanghai's Bund, few know of the Sassoons. Yet theirs was a fabled merchant empire that could once have claimed to be the first truly globe-spanning multinational. In the mid-19th century they were Asia's most powerful business dynasty. Their decline is a warning to tycoons who dream of descendants perpetuating their eminence and riches.

The story begins with David Sassoon. His family were pillars of a Jewish community in Baghdad that dated to the Babylonian captivity. David, like his forebears, was treasurer to the Mamluk rulers of the province. Exactly why he fled from Dawad Pasha, a cruel potentate, is unclear; but as his grandson, Edward Sassoon, recounted, "certain it is that the place got too hot for him." David arrived in Bombay in 1832.

The fact that Edward was an MP in Edwardian England hints at the family's remarkable trajectory. Bombay was the springboard. The Industrial Revolution was in full stride, and the city epitomised a very British marriage of commerce and empire—like much of India, it was run by the East India Company. By the racist standards of the day, Bombay society was tolerant. Enterprising types were welcome, regardless of origins. The family of Jam setji Tata, India's first industrialist, was soon on warm terms with the Sassoons.

No one doubted David's probity. Along with a canny but cautious business sense, he was notable for his philanthropy, including the unfashionable

activity of educating girls. But his strongest ties were with his family. He had eight sons and six daughters by two marriages. In time the sons were sent to run business outposts that stretched from Yokohama to London, via the coast of China, Calcutta and Cairo.

Letters were the family glue, written in the Baghdadi-Jewish dialect. The author of “The Global Merchants” is not a direct descendant of these Sassoons, despite his surname. But he does read the dialect, having himself been born in Baghdad. He brings out both David’s care for his children and his strictness: he expected at least a letter a week from each remote emissary.

The family rode the empire’s cresting wave. One war in particular turbocharged the Sassoon fortunes, when Britain forced Indian opium on China in 1839. The Sassoons became drug-runners, with a return trade in Chinese tea, along with Indian cotton, shipped to Britain. America’s civil war also favoured the Sassoons, who sent their cotton to Lancashire mills cut off from the plantations of the Confederacy.

The family adopted new technology—they were early users of the telegraph—and diversified into shipping and insurance. A competitor encapsulated the period: “Silver and gold, silks, gums and spices, opium and cotton, wool and wheat—whatever moves over sea or land feels the hand or bears the mark of Sassoon & Co.”

Then, in 1864, the patriarch died and sibling rivalry set in. One ambitious son, Elias, set up in competition. Scions drifted to Britain and bought fine houses. The Prince of Wales was a friend. Marriage alliances were made, including with the Rothschilds, whom the Sassoons once regarded as upstarts but carried social cachet.

Moving to Britain sapped the clan’s entrepreneurial juices. Now conflict

hurt them: a cotton slump after the first world war was vicious. The Sassoons had one last fling in the Shanghai of the 1930s, under Victor, a witty playboy and master of the Cathay Hotel. (This part of the story is more fully told in Jonathan Kaufman's "The Last Kings of Shanghai".) But in the end war—first Japanese aggression, then China's civil war, won by the communists—did for Victor's Shanghai venture too.

What remained of the Sassoon empire was now in the hands of outside executives. The Rothschilds and the Tatas had also brought in outsiders, but remained to supervise them. The Sassoons did not bother. The last traces of their business expired with the outside directors being declared unfit by the Bank of England. ■



家业长青

沙逊家族，曾经的亚洲第一大商业王朝

《环球商人》讲述了他们的兴衰故事【《环球商人》书评】

《环球商人》，约瑟夫·沙逊著。艾伦莱恩出版社，412页，30英镑。

在孟买那个破落的渔港或上海外滩以外，很少有人听闻过沙逊家族。然而，这个家族曾是传奇的商业帝国，可说是第一个真正有环球足迹的跨国企业。19世纪中期，他们是亚洲最有权势的商业王朝。对于那些梦想着自己的地位和财富将代代延续的大亨来说，沙逊家族的衰落不啻是一记警钟。

故事始于大卫·沙逊（David Sassoon）。他的家族是巴格达一个犹太社区的中坚力量，这个社区的历史可以追溯到巴比伦囚虏时期。和家族的前辈一样，大卫在巴格达省的马穆鲁克统治者手下担任司库长。他后来从残暴的君主达乌德帕夏（Dawad Pasha）那里逃了出来，确切原因不得而知。不过他的孙子爱德华·沙逊（Edward Sassoon）回忆说，“可以肯定，情势对他非常危急。”大卫于1832年来到孟买。

爱德华是英格兰爱德华时代的下议院议员，从这个身份就可以窥见这个家族非凡的发家之路。孟买成为了起飞的跳板。当时工业革命如火如荼，而这座城市正是英国商业与帝国结合的缩影——和印度大部分地区一样，孟买由东印度公司经营。以当时的种族主义标准看，孟买社会可谓宽容。无论什么出身，任何锐意进取的人都受到欢迎。印度首位实业家贾姆·塞吉·塔塔（Jam setji Tata）的家族很快就和沙逊家族热络起来。

大卫的诚实正直有口皆碑。除了精明而警觉的商业头脑外，他还因乐善好施闻名，包括支持女童教育这一当时并不时兴的做法。但他和自己的家人建立了最牢固的联系。他有两次婚姻，育有八子六女。他的儿子们后来陆续被派往世界各地经营当地的业务，商业版图从横滨延伸至伦敦，中间经过中国沿海、加尔各答和开罗。

用巴格达犹太方言书写的信函成为凝聚家族的力量。《环球商人》（The Global Merchants）的作者虽姓沙逊，但并非沙逊家族的直系后裔。不过他在巴格达出生，通晓当地的这种方言。他在书中刻画了大卫对子女的关爱与严厉：他要求每个远去他乡的子嗣至少每周给他写一封信。

借大英帝国的兴盛之势，沙逊家族扶摇直上。尤其是1839年英国对中国强卖印度鸦片的那场战争让沙逊家族财富暴涨。沙逊家族成为了毒品商人，回程时又把中国茶叶和印度棉花运回英国。美国内战时，兰开夏郡的棉纺厂被切断了美国南部邦盟种植园的供货，沙逊家族为其供应棉花，又大赚了一笔。

他们积极采用新技术——比如很早就开始使用电报，后来又扩张进入航运和保险业。一个竞争对手形象地概括了当时的情景：“金银和丝绸，树胶和香料，鸦片和棉花，羊毛和小麦——只要通过海运或陆运的商品，无不由沙逊公司经手或带着他们公司的印记。”

接下来，身为族长的大卫在1864年去世，子嗣开始争权夺利。野心勃勃的儿子伊利亚斯（Elias）在竞争中占据上风。家族后辈陆续迁往英国，买下豪宅定居。沙逊家族与威尔士亲王攀上了交情，并与其他家族联姻，包括他们一度视之为暴发户却有些社会声望的罗斯柴尔德家族。

在英国的生活消磨了家族的创业野心。他们没能继续在战乱中发达，反而开始屡遭打击：一战后的棉花市场萧条让他们元气大伤。1930年代，在风趣的花花公子、华懋饭店老板维克多（Victor）的带领下，沙逊家族在上海经历了最后的风光。（乔纳森·考夫曼[Jonathan Kaufman]在《最后的上海王》[The Last Kings of Shanghai]中详述了这段故事。）但最后，日本侵华战争以及以共产党获胜而告终的中国内战给维克多的上海事业也划上了句号。

沙逊帝国残存的那部分而后被放在了外部高管的手里。罗斯柴尔德家族和塔塔家族也引入了外人，但仍然监督他们的工作。沙逊家族却不再费这个心。等到英格兰银行宣布这些外部董事不适宜任职后，他们商业帝国的最

后一丝痕迹也随之消散无踪了。■



Schumpeter

Has Silicon Valley lost its monopoly over global tech?

The heartland of the technology industry has become at once less dominant and more so

SILICON VALLEY feels like a college reunion these days. As covid-19 restrictions are lifted across America, tech-bros (and the occasional tech-gal) who have not met in person in ages are high-fiving each other all over the place. Firms from Alphabet to Zynga are urging workers back to the office. Venture capitalists are flocking back from second homes by Lake Tahoe or ranches in Wyoming. Foreigners, who during the pandemic became a rarer sight in San Francisco than unicorns, can again be spotted south of Market Street, a popular pasture for startups valued at \$1bn or more.

The people look the same. Yet the place feels different. Your guest columnist, who is heading to Berlin after spending a total of 12 years, including all of the pandemic, in San Francisco over the past three decades, suspects that many returnees will feel like strangers in a strange land. Not because everyone seems suddenly obsessed with the decentralised “web3” (which they are) or because the valley has peaked (which it hasn’t). Silicon Valley has changed, and not just as a result of the pandemic.

When this stand-in Schumpeter moved there in the mid-1990s, even some top venture capitalists drove lumbering clunkers. Now a zippy Tesla is de rigueur (with a Ferrari often sitting in the garage). Similarly, the hub’s business metabolism, which few places could match to begin with, has sped up. In the pandemic job-hopping became even more rampant and rapid. Many firms offer six-figure cash bonuses and pay rises of 25% to retain talent. Promising startups can raise money in days rather than weeks. Last year more than 17,000 venture-capital (VC) deals were cut in

America, 40% more than in 2020, according to PitchBook, a data provider.

All that money pouring into a limited number of deals helped raise late-stage startups' median valuation to \$115m in 2021, nearly double the level in 2020. Outside investors, including hedge funds such as Tiger Global and Coatue Management that used to invest mainly in public markets, have piled in. These newcomers bring a new philosophy, in which a firm's performance and its fit in the overall portfolio trump conventional VC considerations such as knowing the founder or understanding the industry.

Valuations may already have suffered as a result of rising interest rates. But the cash will not disappear. Non-traditional investors, from private-equity firms to family offices, keep coming. And money isn't the only accelerant. Tech itself has chivvied things along, too. Zoom makes it easier for people to interview for a new job and for entrepreneurs to pitch to potential investors. In the words of Mike Volpi of Index Ventures, a VC firm, "This has created a much more efficient market."

It has also created a much more global one. In the late 1990s Silicon Valley's startup uniform of washed-out T-shirt, shorts and hairy legs was (thankfully) confined to the Bay Area. Today's less off-putting Silicon Valley look—untucked shirt, khaki trousers, white trainers—is the fashion choice of founders everywhere. Less sartorially, whereas as a few years ago a base in the valley was still a must for ambitious entrepreneurs, engineers and investors, now they no longer have to be physically present to get access to capital, talent and know-how. Established tech firms, too, are expanding their geographical footprint. Many are building offices in such places as Austin and New York. A few, including Hewlett Packard Enterprise and Oracle, have relocated their headquarters to Texas. The Brookings Institution, a think-tank, recently estimated that 31% of tech jobs are now offered in "superstar metro areas" such as Silicon Valley, down from 36%

before the pandemic.

VCS, for their part, have learned they do not need to drive to a startup or smell the founder to make a lucrative deal. Sequoia, a VC stalwart, no longer requires live in-person pitches from entrepreneurs and is perfectly happy with pre-recorded video presentations. More of Sequoia's fellow VCs on Sand Hill Road, the historic centre of VC-dom in Palo Alto, are eyeing Europe. Venture investments across the Atlantic have shot up from less than \$40bn in 2019 to more than \$93bn last year—pulling nearly equal with Silicon Valley, according to CBInsights, another data provider.

Sequoia—king of the Sand Hill, having wrested the crown from Kleiner Perkins, the dotcom-era lord—recently opened offices in London. Other VC firms are planning European outposts. Plenty already have Asian ones.

The Bay Area has lost its “geographical monopoly” in tech, sums up Phil Libin, a serial entrepreneur who runs mmhmm, a video-conferencing firm (whose investors include Sequoia). Mr Libin himself now lives in Bentonville, Arkansas, better known as the home of Walmart than as a tech hub.

Some of this dispersion may slow or even reverse. As covid-19 fades into endemicity, even Zoom-hardened venture capitalists would rather interrogate a startup founder over a bottle of a Napa cabernet than over a video call. They may also become more discerning about where to put their capital now that it is becoming costlier. This could favour nearby startups on which it is easier to keep an eye.

| *The valley reforged*

Will all this make Silicon Valley more parochial, and less relevant? Don't bet on it. It is true that the next trillion-dollar company may not come from Silicon Valley, the place, as most of the current crop have done. But the odds are that it will emerge from Silicon Valley, the mindset. Its high-

octane venture capitalism and, increasingly, its capitalists and capital have infused technology scenes from Stockholm to Shanghai and São Paulo. That may be bad news for landlords in San Francisco, second-rate entrepreneurs in Mountain View and other rent-seekers who took advantage of the Bay Area's initial geographical monopoly. For everyone else, be it tech workers south of Market who can at last afford a flat nearby or innovators in Mumbai able to tap Silicon Valley money and expertise, it is a boon. ■



熊彼特

硅谷已失去了对全球科技的垄断吗？

这个科技业心脏地带的主导地位已不似从前，却也更胜从前

硅谷这些日子给人的感觉就像大学同学聚会。随着全美各地解除新冠肺炎防疫限制，久未见面的科技哥们儿（偶尔还有科技姐们儿）都在相互击掌庆祝。从Alphabet到Zynga的公司都在催促员工回办公室去。风险投资者正纷纷从太浩湖边或怀俄明州牧场的第二个家回归。在疫情期间，外国人在旧金山变得比独角兽还罕见，而现在，在市场街（Market Street）以南这片聚集了许多估值10亿美元以上创业公司的区域，又可以见到他们的身影了。

人是而物非。笔者过去30年待在旧金山的时间加起来有12年，疫情期间也一直在那里（不过即将前往柏林）。笔者怀疑，许多归来的人都会觉得自己是来到一片陌生土地的陌生人。这倒不是因为突然间每个人似乎都为去中心化的“web3”神魂颠倒（事实也确实如此），也不是因为硅谷已经见顶（其实还没有）。硅谷变了，而这不仅仅是疫情导致的结果。

笔者在上世纪90年代中期搬到那里时，就连一些顶尖风险投资家也开着笨重的旧车。现在，一辆轻快的特斯拉必不可少（还有一辆常常停在车库里的法拉利）。同样地，这个科技中心原本就罕有对手的商业新陈代谢也已提速。在疫情期间，跳槽变得更家常便饭也更迅速了。许多公司开出了六位数的现金奖励和25%的加薪来留住人才。有前景的创业公司在几天内就能筹集到资金，而用不到几周。根据数据供应商PitchBook的数据，去年在美国达成的风险投资交易超过1.7万笔，比2020年多40%。

这些资金全都被倾注到为数不多的一些交易中，推动了“晚期”创业公司的估值中值在2021年达到1.15亿美元，几乎是2020年的两倍。外部投资者蜂拥而至，包括过去主要投资公开市场的对冲基金，如老虎全球（Tiger Global）和寇图资本（Coatue Management）。这些新来者带来了一种新理念，在选择风投目标时更看重一家公司的业绩及它与整个投资组合的契

合度，而不再是围绕是否认识创始人或了解行业。

由于利率上升，估值可能已经受到了影响。但是现金不会消失。从私募股权公司到家族办公室，非传统投资者接踵而来。而金钱也不是唯一的加速器。科技本身也在推动事情的发展。Zoom让人们更方便面试新工作，也让企业家更方便向潜在投资者推销。用风险投资公司Index Ventures的迈克·沃尔皮（Mike Volpi）的话说，“这创造了一个效率大大提升的市场。”

它还创造了一个全球化程度大幅提升的市场。上世纪90年代末，硅谷创业公司的统一着装——洗到发白的t恤、短裤和毛烘烘的腿——还仅限于湾区（谢天谢地）。如今的硅谷装扮没那么倒人胃口了——没塞进裤子里的衬衫、卡其布裤子、白运动鞋——且已经成了各地创业者的时尚选择。和衣着上的影响力不同，雄心勃勃的企业家、工程师和投资者几年前还必须要在硅谷有个据点，而现在他们无需亲身在场就能获得资本、人才和技术诀窍。老牌科技公司也在扩大它们的地理足迹。许多公司正在奥斯汀和纽约等地建立办事处。包括惠普和甲骨文在内的一小批公司已经将总部迁到了得克萨斯。智库布鲁金斯学会最近估计，现在31%的技术工作是由硅谷之类的“超级巨星都市区”提供的，比疫情之前的36%有所下降。

而风投方也已经认识到，他们不是非得开车去一家创业公司看看或者考察一下创始人才能达成一笔有利可图的交易。风投老字号红杉资本（Sequoia）已不再要求创业者现场推介，而能完全接受预先录制的视频演示。在帕洛阿尔托的沙山路（Sand Hill Road，风投界历史上的中心），更多红杉的风投同行正在放眼欧洲。根据另一家数据供应商CBInsights的数据，大西洋对岸的风险投资从2019年的不到400亿美元飙升至去年的逾930亿美元，几乎追平硅谷。红杉从网络泡沫时代的王者凯鹏华盈（Kleiner Perkins）手中夺下了沙山路之王的桂冠，最近在伦敦开设了办事处。其他风险投资公司正计划在欧洲设置前哨。很多已经进驻亚洲。

旧金山湾区已经失去了它在科技行业里的“地理垄断”，菲尔·利宾（Phil

Libin) 总结道。他创办过多家公司，目前经营着一家视频会议公司 mmhmm（投资者包括红杉）。他本人现在住在阿肯色州的本顿维尔（Bentonville），那里主要以沃尔玛总部闻名，而不是什么科技中心。

这种分散在一定程度上可能会放缓，甚至逆转。随着新冠肺炎逐渐变成地方性流行病，比起打视频电话，即使是对Zoom已十分上手的风险投资家还是更愿意就着一瓶纳帕谷的红酒，当面盘问创业公司的创始人。由于资本成本越来越高，他们也可能更审慎地选择投资对象。这可能有利于那些离他们较近的创业公司，因为监督起来更方便。

| 再造硅谷

这一切会让硅谷变得更闭塞、不再那么举足轻重吗？不大可能。诚然，下一个万亿美元公司可能不会像现在这一批中的大多数那样诞生在硅谷这个地方，但很可能脱胎于硅谷的思维模式。硅谷活力无限的风险资本主义，以及越来越多的硅谷投资家和资本已渗入了斯德哥尔摩、上海和圣保罗等众多地方的科技界。这对于旧金山的房东、山景城的二流企业家和其他利用湾区最初的地理垄断优势的寻租者来说可能是个坏消息。对其他所有人来说——无论是总算能买得起附近房子的市场街以南的技术工人，还是得以利用硅谷的钱和专业经验的孟买的创新者——这都是一件好事。■



Brands and marketing

The serious business of being a social influencer

Read this leader!!#ad

IT IS A sure sign that a hot trend has reached the mainstream when the tax authorities catch up. Last week China promised a tax-evasion crackdown on social-media influencers, who are paid by brands to promote products online to armies of followers. One of the big stars, Viya, a 30-something fashionista known as the live-streaming queen, has already been fined \$210m for not declaring her income. The size of that levy shows the sheer scale of the industry, which accounts for 12% of online sales in China. Outside China, influencers are also likely to have an enduring role in e-commerce. For all firms with brands—and together those brands are worth over \$7trn—it is time to realise that influencing is more than just a hobby.

The use of personal endorsements used to be about harnessing existing celebrity power. Elizabeth Taylor touted Colgate-Palmolive's shampoo in the 1950s, and Michael Jordan's deal in 1984 with Nike revolutionised both basketball and branding. Influencers turn the logic on its head: selling things helps make them more famous. Through curated feeds of clipped videos and filtered photos they offer recommendations to consumers, mingled with glimpses into their daily lives that give their artifice an aura of authenticity. Sometimes they disclose how they are paid. Often they do not.

Initially dismissed as credulous Gen-Z folk who had mistaken posting selfies for having a job, these entrepreneurs have become a big business, boosted further by the e-commerce surge from the pandemic. Total spending on influencers by brands could reach \$16bn this year. Whereas the number of wannabe influencers outside China is in the millions, an elite of under 100,000 of them who have over 1m followers each get the

bulk of revenues and the front seats at fashion shows.

Their staying power suggests that they add value in several ways. They can save money: Elon Musk is an honorary influencer whose raucous online presence lets Tesla do without any conventional advertising (General Motors blew \$3.3bn on it in 2021). Influencers' networks reach new audiences, particularly younger shoppers. Global brands can localise their appeal by cutting deals with them. In China local shopping festivals and style sensibilities matter, so transplanting marketing campaigns from the West does not work. And influencers are technologically proficient in a way that old-style brand ambassadors never were. They are quick to adapt to newer platforms like TikTok and to the ever-changing algorithms of older ones like Instagram.

Yet one-third of brands do not use influencers. They worry about tarnishing their reputation. Having a swarm of freelance advocates is riskier than the command-and-control campaigns of the "Mad Men" era. And the industry is a Wild West, awash with fraud and manipulation.

Despite this, ignoring influencers is a mistake. Their share of digital advertising budgets is still low at perhaps 3%, but it is rising fast. The boundary between entertainment and e-commerce is blurring. And the most popular marketing strategy of the 2010s—ads targeted through Google and Facebook—is under threat as new privacy standards, including on Apple's iPhone, make it harder to spy on potential customers.

To get the most out of influencers, brands should set a clear strategy. They should expect more regulation on consumer protection: China's crackdown may also include limits on spending and content rules. The guiding principle should be to use only influencers who disclose to their audiences that their posts are paid. As the Wild West phase ends, brands should also embrace new analytical tools that help them gauge the performance of

influencers, sorting the con-artists from the stars. It used to be said that only half of all advertising spending worked, but it was impossible to know which half. Now brands can control only half of what influencers say, but they may be able to calculate 100% of the value they add. ■



【首文】品牌与营销

当网红是一门正经生意

读一读这篇文章!!#广告

一个热门趋势被税务机关盯上，就表明它无疑已步入主流。上周，中国表态要严打网红带货中的偷逃税行为。这些网红向品牌收取费用，在网络平台上向大批粉丝推销产品。其中一位大明星是有“直播女王”之称的30多岁的时尚网红薇娅，此前她因瞒报收入而被罚款2.1亿美元。这笔巨额罚款显示了该行业的规模有多么庞大——占中国网络销售的12%。在中国之外，网红也很可能会长驻电商界。对所有拥有品牌（这些品牌总共价值超过七万亿美元）的公司来说，现在是时候意识到网红们不仅仅是在自娱自乐了。

使用个人代言在过去是利用已经出名的人既有的影响力。上世纪50年代有伊丽莎白·泰勒为高露洁棕榄公司的洗发水站台；1984年乔丹与耐克公司签约，彻底改变了篮球运动和品牌推广。网红们却将这套旧逻辑颠倒——推销产品帮助他们变得更出名。他们不断发布精心策划的视频片段和打上滤镜的照片，把向消费者推荐的各式产品融入自己的日常生活片段，让他们这种推销伎俩显得更真实可信。有时他们也会说明自己是收钱发帖，但通常都是秘而不宣的。

这些创业者最初被认为不过是一群容易被忽悠的“Z世代”，误以为发发自拍就是份正经工作。但现在做网红已然是一门大生意，因疫情而急剧增长的电商生意更是为其推波助澜。今年，品牌付给网红的总支出可能达到160亿美元。在中国以外，成百上千万的人做着网红梦，但其中拥有过百万粉丝的不到10万人，这群佼佼者抢到了业内的大部分收入和时装秀的前排座位。

网红们的持久影响力表明，他们能在几个方面增加价值。他们可以省钱：马斯克实际上也算网红，他在社交媒体上大放嘴炮引来的关注让特斯拉根本不用做什么传统广告（2021年通用汽车可是在广告上砸了33亿美元）。

网红可以网罗到新受众，尤其是年轻消费者。全球化品牌可以和网红达成交易，让自己的卖点更接地气。在中国，本土购物节和时尚感觉很重要，所以直接移植西方的营销活动是行不通的。网红对科技的精通程度也是传统品牌大使们难忘项背的。他们能迅速适应TikTok等新平台和Instagram等老平台不断变化的算法。

但仍有三分之一的品牌不使用网红做营销。它们担心声誉受玷污。靠一群自由职业者带货比“广告狂人”时代那种指令控制型推广的风险更大。而且网红业堪称一片“狂野西部”，充斥着欺诈和操弄。

尽管如此，无视网红的力量仍是个错误。他们在数字广告预算中的份额仍然很低，可能只有3%，但正在快速上升。娱乐和电子商务之间的界限逐渐模糊。随着新的隐私标准（包括在苹果iPhone上的规定）出台，平台窥探潜在客户的难度加大，通过谷歌和Facebook投放定向广告这种2010年代最流行的营销策略如今面临威胁。

要充分利用网红的力量，品牌应该制定明确的战略。它们要想到将会有更多保护消费者权益的法规出台。中国的打击措施可能还包括对支出的限制和内容规则。指导原则应该是带货网红要告知受众自己是收钱发帖。随着“狂野西部”阶段结束，品牌也应该采用新的分析工具来衡量网红的营销实效，把骗子和明星区分开来。过去有一种说法，全部广告费里只有一半起了作用，但不可能知道到底是哪一半。现在，品牌只能控制网红一半的言论，但也许能计算出他们带来的全部增值。 ■



Schumpeter

Why Saudi Aramco could be eclipsed by its Qatari nemesis

QatarEnergy puts commercial interests above geopolitical ones

TO SAUDI ARABIA, Qatar is little more than a sore thumb sticking out into the Persian Gulf. For decades the kingdom has looked down on its neighbour as an irritating pipsqueak, with which it has little in common except the desert. Saudi Arabia has historically cut more of a dash in global affairs; the vast fields of natural gas that Qatar controls have never provided it the same clout as its rival's oceans of oil. Saudi Aramco, which produces 12.8m barrels of oil equivalent per day, has just attained a market value of more than \$2.3trn, making it the world's second-most-valuable listed company after Apple. Alongside it, QatarEnergy, which produces less than a third as much, looks like an emir's plaything. Now Russia's war on Ukraine has also exposed a stark contrast in the attitude of the two countries to the world beyond their borders. Their different approaches to energy geopolitics could have big repercussions for both firms, as well as for the West and the East.

Saudi Arabia undoubtedly believes it is on a roll—and in some ways it is. On March 20th Aramco, the world's biggest oil exporter, revealed that soaring oil prices had enabled it to more than double net profit to \$110bn in 2021, when crude averaged around \$70 a barrel. With oil prices now above \$100, the bonanza will grow. The company plans to raise capital expenditure to \$40bn-50bn this year, up from \$32bn in 2021. That will help it towards a goal of adding 1m barrels a day (b/d) of oil-production capacity by 2027.

This stands in contrast to a broad decline in oil investment from the industry as a whole, partly because of pressure to avert climate change. Ironically, the world's most carbon-emitting company, if you count the pollution from burning its oil, appears to be the giant doing the best out of

the energy transition.

At the same time, Saudi Arabia's assertiveness on energy matters is growing. European leaders such as Emmanuel Macron in France and Boris Johnson in Britain have of late set aside revulsion caused by the murder in 2018 of Jamal Khashoggi, a Saudi journalist who wrote for the Washington Post, and have visited Muhammad bin Salman, the crown prince. Mr Johnson pressed him to pump more oil to replace Russia's war-disrupted barrels—but got nowhere. So far the kingdom has remained staunchly committed to miserly short-term oil-production increases agreed with the OPEC+ cartel, which it and Russia in effect control.

If anything, Saudi allegiances now lean more East than West. A few weeks ago Aramco finalised a long-mooted investment in a refining complex in northern China. It will supply most of the 300,000 b/d of crude the complex needs. The kingdom's rulers are in talks with China to price some of the crude supplies in yuan, the Wall Street Journal has reported. If this happens, that would dent the dominance of the dollar in the oil market and jeopardise a deal dating back to the Nixon era when the Saudis created petrodollars in exchange for American security guarantees. Bloomberg recently reported that India's Adani Group, owned by one of the country's wealthiest tycoons, may be considering a range of potential partnerships in Saudi Arabia, including buying a stake in Aramco—a further sign of closer ties with Asia.

There are good commercial reasons for Saudi Arabia's eastward pivot. More than a quarter of its oil exports go to China. Only 10% go to Europe, and 7% to America. Still, Prince Muhammad's regime is unnecessarily antagonising the West by resisting calls to increase output, which it could do without compromising its business. In fact, its resistance seems almost out of spite—and appears to have less to do with commerce and more with the kingdom's security concerns, including ways to contain Iran and its

proxies, which it feels President Joe Biden's administration is ignoring. Underscoring such worries, Yemen's Houthi rebels struck some Aramco facilities with missiles last month.

As with Aramco, QatarEnergy's customers are also mostly Asian. But the emirate, one of the world's biggest exporters of liquefied natural gas (LNG), has a more pragmatic approach to the outside world. It wants strong commercial relations with China—partly to ensure its LNG exports to the Asian giant are not displaced by Russian gas. But that does not prevent it from maintaining strong ties with America. It is loth to put geopolitics ahead of QatarEnergy's economic interests.

Such commercial pragmatism was apparent during the blockade of Qatar by a quartet of Gulf states, including Saudi Arabia and the United Arab Emirates (UAE), in 2017-21, notes Steven Wright of Hamad Bin Khalifa University in Doha. During the stand-off, Qatar kept natural gas flowing through the Dolphin pipeline to the UAE in order to convince the world it was a reliable supplier. It is apparent again in Qatar's response to Europe's gas crisis. In the run-up to the war in Ukraine, it too, like Saudi Arabia, declined Western pleas to send Europe more fossil fuels. Its reasons, though, were more commercial than mercenary. Most of its LNG was simply tied up in sacrosanct long-term contracts. Now that it has spotted a new commercial opportunity as Europe seeks to reduce its reliance on Russian gas, QatarEnergy is happily talking with Germany about long-term gas supplies.

| *Dinosaurs in the desert*

The biggest contrast between the two energy giants may come amid the energy transition. Aramco is betting that its low-cost and, as crude goes, clean oil has a future for years to come. Like Aramco, QatarEnergy is pouring money into more production—in its case, a \$30bn expansion of its natural-gas export capacity.

But a decade from now, when electric cars will no longer be burning Aramco's oil, many of them will still be charged using electricity generated with QatarEnergy's gas. After that, both energy giants see the future in producing hydrogen. At that point, Qatar's efforts to keep on good terms with potential customers on both sides of the geopolitical divide will look more commercially prudent than Saudi huffiness. ■



熊彼特

沙特阿美为何可能被它的卡塔尔对手超越

卡塔尔能源公司将商业利益置于地缘政治利益之上

对沙特阿拉伯来说，卡塔尔充其量就是伸向波斯湾的一根碍眼的小刺。这个王国几十年来都看不起这个邻居，认为它就是个招人烦的弹丸小国，除了沙漠之外跟自己几乎再无共同点。沙特历来在全球事务中更出风头，而卡塔尔虽然控制着广阔的气田，却从未因此获得如沙特的浩瀚油海带给沙特的那般影响力。沙特阿美（Saudi Aramco）日产1280万桶油当量，近日市值已超过2.3万亿美元，成为仅次于苹果的全球市值第二高的上市公司。跟它一比，产量不及它三分之一的卡塔尔能源公司（QatarEnergy）仿佛埃米尔的玩物。如今俄罗斯对乌克兰发起的战争也突显出两国对外部世界截然不同的态度。它们对能源地缘政治采取的不同应对方式不仅可能给东西方世界造成冲击，也将给两家公司都带来巨大的影响。

沙特阿拉伯无疑认为自己眼下顺风顺水——在某些方面的确如此。3月20日，全球最大的石油出口商沙特阿美透露，飙升的油价让它的净利润在2021年翻了一番多，达到1100亿美元，当时原油均价约为每桶70美元。现在油价已突破100美元，它还会继续大发横财。该公司计划今年将资本支出从2021年的320亿美元提高至400亿至500亿美元。这将助其实现到2027年每日增加100万桶的产能扩张目标。

与此形成鲜明对比的是整个行业内石油投资普遍下降，部分原因是遏制气候变化的压力。讽刺的是，世界上碳排放最多的公司（如果算上燃烧它生产的石油所造成的污染）看来也是在能源转型中混得最好的巨头。

与此同时，沙特在能源问题上日趋独断。2018年，为《华盛顿邮报》撰稿的沙特记者贾迈勒·卡舒吉（Jamal Khashoggi）遇害，法国的马克龙和英国的约翰逊等欧洲领导人最近把此事引发的厌憎暂放一边，拜访了王储穆罕默德·本·萨勒曼。约翰逊催促他开采更多石油，以替代因战争而中断的俄罗斯石油供应，但收效甚微。到目前为止，沙特仍坚定执行与欧佩克

+（该卡塔尔由沙特和俄罗斯实际控制）达成的扼门的短期石油增产计划。

真要说起来，沙特现在还是更偏向东方而不是西方。几周前，阿美敲定了一项酝酿已久的投资，要在中国北方建设一座大型综合炼油厂。该厂每日所需的30万桶原油大部分将由阿美提供。据《华尔街日报》报道，沙特的统治者正在与中国谈判用人民币为部分原油供应定价。如果这成真，将削弱美元在石油市场的主导地位，并危及一项可以追溯到尼克松时代的交易，当时沙特创造了石油美元以换取美国保证自己的安全。彭博近期报道称，印度最富有的大亨之一拥有的阿达尼集团（Adani Group）可能正在考虑在沙特建立一系列合作伙伴关系，包括购买阿美的股份——这进一步显示沙特与亚洲关系更密切。

沙特转向东方有很好的商业理由。它的石油出口中超过四分之一流向了美国，只有10%去了欧洲，7%去了中国。然而，王储穆罕默德的政权对增加产出的呼声充耳不闻，正在毫无必要地激怒西方，而增产其实并不会损害其商业利益。事实上，它的抗拒看起来几乎就是为了泄愤，而且看起来与商业关系不大，更多是出于沙特安全上的考虑，包括想办法遏制伊朗及其代理人——沙特觉得拜登政府现在忽略了这件事。上月也门胡塞叛军用导弹袭击了阿美的一些设施，突显了这种担忧。

和阿美一样，卡塔尔能源的客户也大多来自亚洲。但是，卡塔尔这个世界上最大的液化天然气（LNG）出口国之一对外部世界采取了更加务实的态度。它希望与中国建立牢固的商业关系——部分是为了确保它向这个亚洲巨人出口的液化天然气不会被俄罗斯的天然气取代。但这并不妨碍它与美国保持紧密联系。它不愿意将地缘政治置于卡塔尔能源的经济利益之上。

位于多哈的哈迈德·本·哈利法大学（Hamad Bin Khalifa University）的史蒂夫·赖特（Steven Wright）指出，卡塔尔的这种商业实用主义在2017到2021年间显露无疑，当时，包括沙特和阿联酋在内的四个海湾国家对卡塔尔实施了封锁。对峙期间，卡塔尔持续通过“海豚”（Dolphin）管道向阿联酋输送天然气，让世界相信它是一个可靠的供应国。这种实用主义在

卡塔尔对欧洲天然气危机的反应中再次显现。在乌克兰战争前夕，它也像沙特一样，拒绝了西方向欧洲输送更多化石燃料的请求。不过它这么做更多是基于商业契约，而非唯利是图。它的大部分液化天然气其实都已被神圣不可动摇的长期合同锁定。随着欧洲寻求减少对俄罗斯天然气的依赖，卡塔尔能源如今发现了一个新商机，正愉快地与德国谈判长期天然气供应。

| 沙漠中的恐龙

两个能源巨头之间最大的差异可能会在能源转型的过程中显现出来。阿美押注其低成本且清洁的（就原油而言）石油在未来几年仍有前景。和阿美一样，卡塔尔能源也在为增产注资，不过它是砸下300亿美元扩充天然气出口产能。

但十年后，当电动汽车都不再烧阿美的石油，它们许多仍会使用卡塔尔能源的天然气发的电。再往后，两个能源巨头都认为出路是生产氢能。到那时，比起沙特耍横，卡塔尔与分处地缘政治裂谷两侧的潜在客户保持良好关系的努力会更显商业上的审慎明智。 ■



Cyber-roaches

Robotised insects may search collapsed buildings for survivors

They can detect movement, body warmth and exhaled carbon dioxide

WHY GO TO all the trouble of designing and building a drone if nature has already done most of the job for you? That is the attitude taken by the small but determined band of researchers who are trying to robotise insects. Some are working on turning flying critters like beetles into such cyborgs—perhaps for use in military reconnaissance or espionage. Others prefer to concentrate on the creepy-crawly side of entomology, by taking electronic control of cockroaches.

The first cyber-roach goes back to 1997, when Shimoyama Isao of Tokyo University sent electrical signals to a cockroach's antennae, causing it to turn either left or right depending on which antenna was stimulated. Others have built on this approach by recruiting extra sense organs, such as the rear-facing cerci. They have also begun fitting the insects with instrument packs that might let them do a useful job: searching collapsed buildings for survivors.

One such is Sato Hirotaka of Nanyang Technological University, in Singapore. He has been working on cyber-insects (including flying versions, in the form of giant flower beetles) for 15 years. Now, he has added another twist to cyber-roaches. Instead of having their movements dictated by remote control, his are autonomous agents. They are run by algorithms that respond directly to sensors in their backpacks.

The insects thus fitted out by Dr Sato are Madagascar hissing cockroaches, which are about 6cm long. The backpacks contain a communications chip, a carbon-dioxide sensor, a motion sensor, an infrared camera and a tiny battery.

For search-and-rescue operations in collapsed buildings, fleets of these roaches would be released into the rubble, to crawl their way through while searching for signs of life such as movement, body heat and elevated CO₂ levels from respiration. The artificial intelligence that decides whether a set of signals actually indicate the presence of a human being is programmed directly into the camera. If it thinks it has spotted someone, it alerts a rescuer.

To test this arrangement, Dr Sato and his team ran trials in a simulated disaster zone. They laid out concrete blocks of various shapes and sizes in an area of 25 square metres. Interspersed among these were a number of people, and also some decoys, such as a heat lamp, a microwave oven and a laptop. They then released the cyber-roaches, having first programmed into them the search's start and end points. The software proved able to recognise humans correctly 87% of the time, a success rate Dr Sato thinks could be improved still further by collecting multiple images from different angles.

The next phase of the project is to refine the system for use out of doors. That done, manufacture of the backpacks and automation of their attachment to the insects will need to be commercialised. If all goes well, Dr Sato reckons the result could be available for deployment within five years. ■



赛博蟑螂

机械化昆虫可能成为废墟搜救奇兵

它们可以探测人体活动、体温和呼出的二氧化碳【新知】

既然大自然差不多已经提供了现成的，何必还要费那么大劲去设计和制造无人机呢？一群为数不多但意志坚定的研究人员就是这个态度，他们正试图对昆虫做机械化改造。一些人研究如何把甲壳虫之类的飞虫改造成半机器生物——或许可以用于军事侦察或间谍活动。另一些人选择捣鼓爬来爬去有点吓人的那一类——对蟑螂实施电子化操控。

第一只赛博蟑螂可以追溯到1997年，当时东京大学的下山勲向蟑螂的触须发送电信号，使其向左或向右转动——待看受刺激的是哪侧的触须。在此基础上，其他研究者尝试操控其他感觉器官，例如向后的尾须。他们还开始给蟑螂装上仪器包，这样它们说不定就可以做一项有用的工作：在倒塌的建筑物中搜寻幸存者。

新加坡南洋理工大学的佐藤裕崇就是其中一位研究者。15年来，他一直在研究赛博昆虫（包括会飞的巨型花金龟）。现在，他又给赛博蟑螂增添了新花样。它们的行动不再受远程控制，而是成为自主行动的主体。算法根据仪器背包里传感器的信号直接驱使它们行动。

佐藤使用的是马达加斯加发声蟑螂，体长约六厘米。它们扛上的仪器背包里装有通信芯片、二氧化碳传感器、运动传感器、红外摄像机和微型电池。

在倒塌的建筑物里开展搜救时，这些蟑螂将被成批释放到废墟中，四处爬行寻找生命迹象，如人体移动、体温，以及由呼吸引起的二氧化碳浓度升高。摄像机中直接编入了人工智能程序，可以判断一组信号是否真的显示有人存在。如果程序认为自己发现了幸存者，就会向救援人员发出警报。

为了验证效果，佐藤和他的团队在一个模拟灾区进行了试验。他们在25平

方米的范围内布置了各种形状和大小混凝土块，当中散布着一些人，也放置了一些干扰物，如保温灯、微波炉和笔记本电脑。他们将搜索的起点和终点输入程序，然后释放了这些赛博蟑螂。结果证明，该软件成功识别人类的准确率达到87%。佐藤认为如果从不同角度采集多个图像，成功率还可以进一步提高。

该项目的下一步是改进系统以应用于户外。这一步完成后，将需要实现背包制造以及背包与蟑螂自动装配的商业化。如果一切顺利，佐藤估计这一成果将在五年内投入使用。 ■



Ukraine's internet connectivity

The degrading treatment of Ukraine's internet

And how the Ukrainians are responding

DEGRADING AND ideally destroying your opponents' ability to communicate are elementary military tactics. And, in its war on Ukraine, Russia has certainly attempted to do this. These days, closing down communications focuses on the enemy's internet capabilities. So it is not surprising that analyses by NetBlocks, a firm in London that monitors internet activity, suggest that the number of devices connected to Ukraine's internet has fallen by nearly a quarter since Russia's onslaught began. Alp Toker, NetBlocks' founder, describes that loss as striking. But it could be a lot worse, for it means that most Ukrainians are still online. What is going on?

For one thing, Ukraine boasts an unusually large number of internet-service providers—by one reckoning the country has the world's fourth-least-concentrated internet market. This means the network has few choke points, so is hard to disable. In this, indeed, it fulfils one objective of the internet's ancestor from the 1970s, ARPANET, which was intended to be similarly resilient to attack. Repair crews, for their part, are toiling heroically, including, when possible and more efficient, by fixing equipment owned by competitors.

As for cyber-attacks, at the invasion's outset hackers shut down a proportion of the satellite links that Viasat, an American firm, provides to clients who include Ukraine's armed forces. That attack appears to have been an upload of malware disguised as a legitimate software update. Overall, however, cyber-attacks have not been as disruptive as feared. This suggests that "cyber aid" provided by the West in recent years was money well spent. Josh Lospinoso, who used to help America's army and National

Security Agency (NSA) develop hacking software, says Ukraine's cyber-resilience could be a sign that agencies in NATO countries are assisting on the sly.

Beyond all that, Russian units seem to be leaving parts of the network alone, at least for now. These include sections that are accidentally providing them with data on targets, reckons Kenneth Geers, also once an official at the NSA and now working at the NATO Co-operative Cyber Defence Centre of Excellence, in Tallinn, Estonia. Dr Geers says Russians are feeding information to artillery teams by scanning social media and studying intercepted texts and calls, looking for messages that reveal military savvy and intent. If they can find out where the senders are, artillery strikes may follow.

That implies Ukrainian carelessness. But another reason Russian forces are deliberately preserving parts of Ukraine's telecommunications is that their own gear for military communications is scarce or underperforming.

| *Pursuing plans B and C*

On the whole, though, Russia wants to stop Ukrainians conversing. So, to counter the loss of power and connectivity thus imposed, a range of lash-ups, workarounds and jury-rigs are being prepared.

Some use available materials. Yuri Vlasyuk, boss of iLand, a computer store in Kyiv, says batteries that power electric vehicles are being employed to make power banks for use during blackouts. However, electric cars are still uncommon in Ukraine, so Mr Vlasyuk called some friends in the Czech Republic and Lithuania to help out. Eventually, they managed to ship several hundred electric-car batteries to Kyiv. If the electricity does go out there, the assembled battery packs will power smartphones and other gear. Mr Vlasyuk says his gizmos have been distributed across Kyiv and to soldiers on the front.

An additional approach is to extend a phone's range—a handy trick if nearby cell towers are destroyed. This can be done using commercial devices called signal boosters, but makeshift range-extension antennae also work. These are made with lengths of coaxial cable and conductive household materials, “copper wire, Coca-Cola can, empty, this kind of stuff”, says a retired radio-communications engineer in Warsaw who follows wartime jury-rigging of this sort. In the right conditions, such contraptions can triple a mobile phone's range to about 15km, greatly increasing the number of towers it is able to talk to.

Then there are shortwave-radio hams. Many of Ukraine's roughly 15,000 amateurs are now manning radios for military or intelligence units, says Artem Biliy, a ham operator in Lviv. To assist with this, Ukraine has temporarily banned conventional ham transmissions. But, if needed, hams could constitute a sort of alternative internet, Mr Biliy notes. With the use of modem software, digital data on smartphones and computers can be converted into analogue signals for shortwave transmission. Using the same software, radio operators hundreds of kilometres away can translate the signals into text or images. But this is cumbersome. It takes several minutes to send a low-resolution photo from one ham radio to another.

Which is where Elon Musk comes in. Responding to a plea for help from Ukraine's government, Mr Musk, head of SpaceX, an American rocketry firm, quickly provided internet terminals that connect to a constellation of satellites called Starlink. Because Starlink satellites orbit a mere 550km up, the service is faster than those that rely on geostationary satellites nearly 36,000km away.

Early batches of these terminals went to eastern and central Ukraine. The first shipment to the country's west arrived in Lviv on March 22nd. Lviv IT Cluster, a group of information-technology firms that are collaborating with SpaceX, is speedily distributing the terminals. How many there are is a

secret. But Stepan Veselovskyi, Lviv IT Cluster's head, says there are enough for hospitals, utilities and rescue services, and also for "critical" government offices, military units and businesses. Smartphones and computers that connect to a Starlink terminal via Wi-Fi download about 150 megabytes of data a second, enough for 12 minutes of video.

To assist their wartime use, SpaceX has tweaked the terminals to draw power from vehicle cigarette-lighter sockets, and has provided special adapters to that end. It has also shipped more conventional power sources, in the form of solar arrays, battery packs and electricity generators. Starlink is the closest thing Ukraine will get to a backup internet. Russian officials are angry. Dmitry Rogozin, head of Russia's space agency, Roscosmos, slammed Starlink as "the West we should never trust".

Using Starlink does carry a risk. The terminals' emissions make them bright targets for missiles designed to seek radar emplacements, says a colonel in Ukraine's army. For this reason, he says, troops will use Starlink only as a backup. Also, though Starlink is useful, if internet and telecoms networks were to break down it would be able to connect only a tiny fraction of Ukraine's population. That population does, however, seem so far to be making a pretty good fist of keeping these networks going by other means.





乌克兰的网络连接

被削弱的乌克兰互联网

乌克兰人的应对之策

削弱乃至摧毁对手的通讯能力是基本军事战术。在对乌克兰发动的战争中，俄罗斯当然也试图这么做。如今，掐断通讯的核心是掐断敌人的互联网连接。因此也就不奇怪，为何伦敦的互联网活动监测公司NetBlocks分析发现，自俄罗斯发动攻击以来，乌克兰的联网设备减少了近四分之一。NetBlocks的创始人阿尔普·托克（Alp Toker）称这一数量上的锐减令人震惊。但情况本可能糟糕得多，因为这意味着大多数乌克兰人仍然可以上网。这是怎么回事？

首先，乌克兰的互联网服务供应商数量异常之多——根据一项估算，乌克兰互联网市场的集中度在全球排名倒数第四。这意味着乌克兰的整个网络没什么阻塞点，所以很难让它瘫痪。在这一点上，它的确实现了阿帕网（ARPANET）这个上世纪70年代的互联网前身的一个设计目标，就是想要具有类似的抗攻击能力。至于维修人员，他们正在英勇奋战，包括在可能也更高效的情况下，修理属于竞争对手的设备。

再来看网络攻击。在俄罗斯入侵之初，黑客掐断了美国公司Viasat向包括乌克兰军队在内的客户提供的部分卫星链路。这种攻击似乎是通过上传伪装成合法软件更新的恶意软件实施的。不过总体而言，网络攻击的破坏性并没有人们担心的那么大。这表明西方近年来对乌克兰提供的“网络援助”物有所值。曾帮助美国军方和国家安全局（NSA）开发黑客软件的乔什·洛斯皮诺索（Josh Lospinoso）表示，乌克兰的网络韧性可能表明北约各国相关机构正在暗中协助。

除此之外，俄罗斯部队似乎放过了乌克兰的一部分网络，至少目前是如此。同样曾是美国国安局官员、现就职于爱沙尼亚塔林（Tallinn）的北约合作网络防御卓越中心（NATO Co-operative Cyber Defence Centre of Excellence）的肯尼斯·吉尔斯（Kenneth Geers）认为，这其中就包括无

意间为俄罗斯部队提供进攻目标数据的那部分网络。吉尔斯指出，俄罗斯正在扫描社交媒体并研究截获的短信和电话，寻找透露出军事技能和意图的信息，提供给自己的炮兵部队。如果他们能找到信息发送者的位置，炮击可能会随之而来。

这说明了乌克兰方面的疏漏之处。但俄罗斯军队故意保留乌克兰部分通讯网络的另一个原因是它们自己的军事通讯设备数量不足或性能不佳。

| 多项备选

不过总的来说，俄罗斯还是希望阻断乌克兰的通讯。因此，为应对由此造成的停电与网络中断，乌克兰在准备一系列应急措施、变通办法以及应急设备。

有些人就地取材。基辅电脑商店iLand的老板尤里·弗拉苏克（Yuri Vlasyuk）说，电动汽车上的电池正被部署用作停电时的移动电源。不过电动汽车在乌克兰还不多见，因此弗拉苏克向捷克和立陶宛的朋友求援。最终，他们设法给基辅运送了数百套电动汽车电池。一旦基辅真的停电，这些电池组将为智能手机和其他设备供电。弗拉苏克说，他发明的这种移动电源已经分发到整个基辅和前线部队。

还有一种方法是扩大手机的信号接收范围——这在附近的手机基站被毁时是个便捷的办法。这可以通过名为信号增强器的商业设备来完成，但临时制成的信号放大天线同样管用。它们用同轴电缆和可导电的家用材料制成，比如“铜线、空可乐罐，这类东西”，华沙一位退休的无线电通信工程师说。他平时关注这类战时应急设备的制作。条件合适的话，这种装置可将手机信号接收范围扩至三倍，达到约15公里，大大增加了手机能联络的基站数量。

此外还有短波无线电通讯爱好者。在乌克兰约有1.5万这样的人，其中很多目前在为军队或情报部门操作无线电，利沃夫（Lviv）的无线电通讯爱好者阿尔特姆·比利（Artem Biliy）表示。为方便他们操作，乌克兰已经暂时禁止了常规的业余无线电传输。不过比利指出，如果需要，无线电通讯

爱好者可以创建一种替代互联网。利用调制解调器软件，智能手机和电脑上的数字化数据可以转换成模拟信号，然后用短波发送出去。数百公里以外的无线电操作员用同样的软件可将模拟信号转换成文字或图像。但这种办法效率低下——业余电台之间发送一张低分辨率照片需要好几分钟时间。

正因如此，马斯克就有了用武之地。应乌克兰政府的请求，这位美国火箭公司SpaceX的老板很快便提供了互联网终端，可以连接到名为星链（Starlink）的卫星群。因为星链卫星轨道距地球仅550公里，它比距离地球将近36,000公里的同步卫星提供的网速要快。

早期提供的星链互联网终端设备运到了乌克兰的东部和中部。首批运往乌克兰西部的终端于3月22日抵达利沃夫。与SpaceX合作的利沃夫IT集群（Lviv IT Cluster）汇聚了一批信息技术公司，正在迅速分发这些终端。终端的数量属于机密。但利沃夫IT集群的负责人斯捷潘·维谢洛夫斯基（Stepan Veselovskyi）表示，它们不仅够医院、公用事业和救援服务机构使用，也够“关键”的政府部门、军事单位和企业使用。通过Wi-Fi连接到星链互联网终端的智能手机和电脑每秒可下载约150MB的数据，足够下载12分钟的视频。

为方便战时使用，SpaceX对终端做了一些改装，可以连接车载点烟插座取电，并为此配备了专门的适配器。SpaceX同时也提供了电池组、太阳能电池板以及发电机等更通用的电源。星链是乌克兰能获得的最接近于备用互联网的东西。俄罗斯官员对此很光火。俄罗斯联邦航天局（Roscosmos）局长德米特里·罗戈津（Dmitry Rogozin）大骂星链是“我们决不能相信的西方玩意儿”。

使用星链确实存在风险。乌克兰军队的一名上校说，这些终端发射的信号很容易被专门追踪雷达位置的导弹盯上。他说，出于这个原因，部队只会拿星链当备用。而且，尽管星链有用，但一旦互联网和电信网络瘫痪，它也只能在乌克兰很小一部分人群中建立连接。而目前看来，这些人确实通过其他方式成功地保持着这些网络的运行。■



Full metal jackpot

The transition to clean energy will mint new commodity superpowers

We look at who wins and loses

IN MID-FEBRUARY Russia seemed on the verge of a revolution with a distinctly reddish tint. Alisher Usmanov, an oligarch, was developing Udokan, a copper mine in Siberia that required removing an entire mountain top. In the Arctic tundra Kaz Minerals, a mining firm, had raised enough cash to build Baimskaya, a rival mine so remote that it needed its own port, icebreaker and floating nuclear plant. For years the projects had been put on hold because of their immense costs. But expectations of soaring demand for copper, used in everything from grids to turbines, had boosted prices of the auburn metal, making the mines viable.

Now the copper price is even higher. But the projects are in trouble. Insiders say they are short of vital foreign equipment that has been blocked by the West after Russia's invasion of Ukraine, and that they are starved of the funds they had expected from blacklisted Russian banks. Mr Usmanov, too, faces sanctions. A spokesman for Udokan says, "We are doing everything we can to ensure business continuity." Yet even if the mine starts producing this year as planned, it is unclear who will buy its output. Foreigners, even the Chinese, are shunning Russian production.

As the world weans itself off dirty fuels, it must switch to cleaner energy sources. The International Energy Agency (IEA), an official forecaster, predicts that wind and solar could account for 70% of power generation by 2050, up from 9% in 2020, if the world embarks on a course to become carbon-neutral by 2050. That translates into huge demand for the metals, such as cobalt, copper and nickel, that are vital for the technologies underpinning everything from electric cars to renewables; the IEA reckons that the market size of such green metals would increase almost seven-fold

by 2030. And much like fossil-fuel reserves, these commodities are distributed unevenly (see chart 1). Some countries have none at all. Others are blessed with vast deposits.

The metals rush will not be as big as the oil-and-gas boom that toppled King Coal after the second world war. But there are some echoes with the past. Between 1940 and 1970 the share of hydrocarbons in the energy supply of rich countries rose from 26% to nearly 70%. Once-marginal economies in the Middle East were transformed into uber-rich petrostates. Between 1970 and 1980 the GDP per person of Qatar and Saudi Arabia grew 12- and 18-fold, respectively. Bedouin villages became boom towns; fishing dhows gave way to super tankers and luxury yachts.

This time the transition will bring windfalls to countries we dub the “green-commodity superpowers”. We calculate that this club, many of which are poor economies and autocracies, could pocket more than \$1.2trn in annual revenue from energy-related metals by 2040.

With the opportunity, however, come risks. As the troubled mining projects in Russia show, important investments can become victims of local conditions and geopolitics. Huge rents could corrode domestic markets and political institutions; autocrats enriched by electrodollars could make mischief beyond their borders. Saad Rahim of Trafigura, a trading firm, says the shift to clean fuels is “less an energy transition than a commodity transition”. It will be a turbulent one.

The green boom is not just another “supercycle”, as prolonged periods of high commodity prices are known. The last such cycle, early this century, was fuelled by rapid urbanisation and industrialisation in China. The combined real GDP of Brazil and Russia, two resource-rich economies, grew by two-thirds between 2000 and 2014. But the rally was largely driven by China alone. When the country’s leaders decided it should build fewer

factories and flats, the commodity giants suffered. The green transition, by contrast, stems from the decisions of many governments, not one. And decarbonising the world is likely to be the job of decades.

Another big difference lies in the materials in demand. China's splurge burned through heaps of coal, iron and steel. The green boom centres on non-ferrous metals that are more niche. Their combined annual revenues today, at \$600bn, is equivalent to only a fifth of that of the bulk materials that China favoured. There may be more explosive growth to come.

To understand which commodity producers stand to win and lose from a green transition, we construct a simple scenario for the use of ten "energy-linked" commodities in 2040, assuming that global warming by 2100 stays below 2°C. Based on data from a range of industry sources, we project demand and revenue for three fossil fuels (oil, gas, coal) and seven metals (aluminium, cobalt, copper, lithium, nickel, silver and zinc) that are critical to building an electricity economy. We assume that prices remain at today's elevated levels, prompting miners to exploit untapped deposits. And we assume that a producer's market share in 2040 is in line with its share of known reserves.

Our findings suggest the world will be less reliant on energy-related resources in 2040 than it is today—largely because wind and sunshine, the sources of the future, are free. Total spending on our basket of ten commodities falls to 3.4% of global GDP, from 5.8% in 2021. Spending on fossil fuels, relative to world GDP, falls by half (and would shrink further were it not for gas). The revenue from green metals remains smaller, but rises from 0.5% to 0.7% of GDP. It nearly triples in absolute terms.

The number of big producers of energy-linked commodities falls over time: 48 stand to pocket sales equivalent to more than 5% of their GDP, down from 58 in 2021 (see chart 2). More than half of total spending goes towards

autocracies.

You can group producers into three buckets, based on the expected change in their revenues from the ten energy-linked commodities between now and 2040. The first comprises the winners—the green superpowers. These electrostates include some rich democracies. Australia has troves of every metal included in our sample. Chile is home to 42% of the world's lithium reserves and a quarter of its copper deposits, much of them in the Atacama desert (pictured above). Others are autocracies. Congo has 46% of global cobalt reserves (and produces 70% of the world's output today). China is home to aluminium, copper and lithium. Poorer democracies in Asia and Latin America may also hit the jackpot. Indonesia sits on mountains of nickel. Peru holds nearly a quarter of the world's silver.

The second bucket comprises countries with revenues that stay flat, or fall a little. It includes the low-cost members of the Organisation of the Petroleum Exporting Countries (OPEC)— including Iran, Iraq and Saudi Arabia—and Russia. Although oil revenue shrinks, their share of it expands from 45% today to 57% in 2040. Other countries, such as America, Brazil and Canada, lose fossil-fuel earnings but are able to tap vast mineral deposits.

Higher-cost petrostates lose the most. Many oil-rich nations in north Africa (Algeria, Egypt), sub-Saharan Africa (Angola, Nigeria) and Europe (Britain, Norway) see their revenues shrivel. Small states like South Sudan, Timor Leste and Trinidad have theirs hit hard. The pain does not spare some Gulf states: the proceeds captured by Bahrain and Qatar, for instance, decline by a fifth or more.

What might prevent the new commodity superpowers emerging? The key ingredient is capital spending. The IEA estimates that major mines that came online in the past decade took, on average, 16 years to build. To meet

booming demand by 2040, the industry must splash out on new projects now. The sums required are big. Julian Kettle of Wood Mackenzie, a consultancy, reckons \$2trn must be spent on green-metal exploration and production (E&P) by 2040. Recent projects suggest digging out enough copper and nickel alone would require \$250bn-350bn in capital expenditure (capex) well before 2030.

| *Pedal to the metal*

Some of the outlay is taking place. Anglo American, a miner, aims to expand its copper output by 50-60% by 2030. “We will deliver our part of the bargain,” says Mark Cutifani, its boss. Many others will not. Burnt by the commodity crash of the mid-2010s, mining majors have reduced investment. Liberum Capital, an investment bank, calculates that annual copper E&P capex has fallen by half since 2014, to \$14bn. As prices rise, so do profits. But cash is being given back to investors rather than redeployed. “Supply growth has almost become a dirty word,” says Stephen Gill of Pala Investments, a venture-capital firm.

Only China is spending a lot. In Kolwezi, in Congo’s cobalt belt, barefoot children greet all foreigners with shouts of “ni hao”. Chinese groups have nabbed most big commercial deposits; Albert Abel, an artisanal miner, complains they have bought most small mines too. Glencore, an adventurous Swiss trader, is the only Western firm to have a foothold. In Indonesia Chinese miners are clearing swathes of rainforest to dig out nickel.

The capex drought is a result of three daunting problems: the industry’s limited firepower, diminishing investment returns and rising political risk. Start with firepower. Though what miners must spend over two decades is equivalent to only four years of typical oil E&P capex, it still seems beyond the capacity of the comparatively tiny sector. Even big miners can only fund one serious project at a time.

This might be fixed by tapping capital providers beyond the majors' usually cautious public-market investors. These could include vertically integrated manufacturers that rely on scarce minerals. Tesla, an electric-car maker, has promised to buy the future nickel production of mines in Australia, Minnesota and New Caledonia. Private-equity firms and state-backed national champions tasked with securing supply could also chip in.

A second problem is the worsening quality of mineral deposits. Udokan says it is the last potential mine with copper content above 1% of the rock. The average grade of Chilean copper has fallen by 30% over the past 15 years, to 0.7%. Lower grades are pushing up extraction and processing costs (and carbon emissions). "Today we use 16 times more energy to make the same pound of copper as we did 100 years ago," says Mr Cutifani.

Innovation may help. Last year BHP, another miner, and Equinor, Norway's state-backed energy firm, invested in an artificial-intelligence startup that sifts through 20m pages of state and scientific archives to identify where new deposits might lie. In time technological breakthroughs could even make exploring sea floors profitable. The world's 67,000km of mid-ocean ridges contain a lot of copper, cobalt and other minerals. This, too, could mint electro states: Fiji (8%) and Norway (5.5%) hold the most economic rights to those ridges.

Yet innovation also makes future returns less certain. The durably high prices that miners need to invest will also encourage big buyers to seek alternatives to the dearest metals. Tesla's batteries include less than 5% cobalt, down from one-third just a few years ago. Innovation could also facilitate recycling. By 2040, the IEA reckons, extracting cobalt from old batteries could help meet 12% of total demand.

| *Game of stones*

Perhaps the biggest risk to investment comes from politics. The minerals

mania stands to make some poor economies rich overnight. The story of commodity booms over centuries, including the hydrocarbon bonanza, shows that this resource blessing can also be a curse, which could in turn discourage further investment.

Gigantic oil rents have made many countries unstable. Rival factions vie to control riches, fuelling inequality and strife. Vast dollar inflows buoy local currencies, crushing exporters. Debt binges during boom times trigger fiscal crises when the cycle turns. Resentful populations make domestic politics even more fractious. Take Nigeria. In 1965 it exported ten different commodities, from cocoa to tin. Two decades of oil discoveries later, petroleum accounted for 97% of its merchandise exports, and had contributed to political instability.

The worry now is that history repeats itself. Some extractors are poorly equipped to manage windfalls. The majority of the world's 96 commodity-linked sovereign-wealth funds are backed by sales of fossil fuels; only seven green-metals exporters have established rainy-day funds, according to Global SWF, a data provider. That is despite a big need for them: much of the spending on metals is expected to take place by 2050, after which demand will ebb and exporters could face leaner times.

Even the prospect of a bonanza could tempt governments to extract more rents from firms. Some tensions are already emerging. Rio Tinto, the world's second-largest miner, was able to restart a long-stranded Mongolian project only after agreeing to write off \$2.4bn in loans to the government. In January Serbia withdrew the firm's exploration permits after protests over plans for a big lithium mine. Peru's new leftist president is mulling higher taxes; one of its biggest copper mines has been blockaded for weeks by locals demanding a share of profits. Chile is debating nationalising copper and lithium as it works on a new constitution.

This volatile environment suggests metals may have to become pricier still before foreign firms think it worth taking a gamble. Price rises so far have already sent some Western miners to frontiers once deemed too perilous to explore. On March 20th Barrick Gold, a Canadian firm, signed a deal to invest \$10bn in a copper mine on Pakistan's border with Iran and Afghanistan. BHP is returning to Africa with an investment in Tanzania.

But prices may still not be high enough. Last year Ivan Glasenberg, then Glencore's boss, said copper may have to hit \$15,000 a tonne, up from today's record \$10,000, to truly incentivise new supply. The higher prices go, however, the more they run the risk of depressing demand, or making local politics yet more volatile. Either could cause investment to stall again.

Many would-be green giants know they can help avoid climate catastrophe. "If we stop mining, we won't be able to cut emissions," says Juan Carlos Jobet, a former energy minister of Chile. To realise their super powers, though, they will need to break the curse.

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全金属大奖

向清洁能源的转型将铸造新的大宗商品超级大国

我们看看谁赢谁输【深度】

二月中旬，俄罗斯似乎处于一场革命的边缘，一场带点独特红色调的革命。寡头阿利舍尔·乌斯马诺夫（Alisher Usmanov）正在开发位于西伯利亚的乌多坎（Udokan）铜矿，需要夷平整整个山头。在北极冻土带上，矿业公司Kaz Minerals筹集到了足够的资金来建设拜木斯卡亚

（Baimskaya）铜矿，这个与乌多坎竞争的矿场地处偏远，需要自己的港口、破冰船和浮动核电站。多年来，巨额建设成本一直让这两个项目处于搁置状态。但是，由于人们预期对铜的需求（用于从电网到涡轮机的各种设施）将飙升，推高了这种赤褐色金属的价格，让这两个铜矿的开发变得可行。

眼下铜价比2月中旬时还要高。但这两个项目遇到了麻烦。知情人士表示，俄罗斯入侵乌克兰后，西方的封锁让它们缺乏关键的外国设备，而原本计划从俄罗斯的银行获得的资金也因为这些银行上了黑名单而落空。乌斯马诺夫本人也面临制裁。乌多坎的一位发言人说：“我们正在竭尽所能确保业务连续性。”然而，即使该矿今年能按计划开始产铜，也不清楚有谁会去买。外国企业——甚至中国企业——都在回避俄罗斯的矿产。

全球要摆脱对污染性化石燃料的依赖，就必须向更清洁的能源转型。官方预测机构国际能源署（IEA）预测，如果要在2050年实现全球碳中和，那么届时风能和太阳能可能要占到发电量的70%，远高于2020年的9%。这就形成了对钴、铜和镍等金属的巨大需求，这些金属对于支撑从电动汽车到可再生能源等各类事物的技术不可或缺。IEA估计，到2030年，此类绿色金属的市场规模将增长近六倍。而与化石燃料储备非常相似的一点是，这类金属矿产资源分布不均（见图表1）。有些国家一无所有，另一些国家储量非常丰富。

这轮“淘金属热”的规模不会像二战后推翻了“煤炭王”的油气繁荣那样大，

但仍有一些似曾相识之处。1940年至1970年间，碳氢燃料在富裕国家能源供应中的份额从26%上升到近70%。中东各国从不起眼的小经济体摇身一变，成为超级富裕的石油国家。1970年至1980年间，卡塔尔和沙特阿拉伯的人均GDP分别增长了11倍和17倍。贝都因人（Bedouin）的村庄变成了繁荣的城镇，三角帆捕鱼船让位给了超级油轮和豪华游艇。

这一次，能源转型将为本刊称之为“绿色大宗商品超级大国”的国家带来大笔横财。据我们计算，到2040年，这个俱乐部（其中许多是穷国和专制国家）可以从能源相关金属中获得超过1.2万亿美元的年收入。

然而，风险也伴随机遇而来。正如俄罗斯麻烦缠身的矿山项目所表明的那样，重要投资可能会成为本地局势和地缘政治的牺牲品。高额经济租可能会腐蚀国内市场和政治机构；靠电力美元致富的独裁者可能会在他们的国界之外捣鬼。贸易公司托克（Trafigura）的萨阿德·拉希姆（Saad Rahim）表示，向清洁燃料过渡“与其说是能源转型，不如说是大宗商品转型”。这个转型过程将动荡不安。

绿色能源热潮不仅仅是另一个“超级周期”（即大宗商品价格长期处于高位时期）。上一个超级周期出现在本世纪初，由中国快速的城镇化和工业化推动。资源丰富的巴西和俄罗斯的实际GDP之和在2000年至2014年期间增长了三分之二。但这一增长主要是由中国一国推动的。当中国领导人决定放慢工厂和住宅的建设步伐时，这些大宗商品大国就感受到了痛苦。与之不同的是，绿色转型源于多国而非一国政府的决策。而全球脱碳很可能需要几十年的时间。

另一个大不同在于所需的原材料。中国的建设大潮消耗了大量的煤炭和钢铁。而绿色能源热潮的需求集中在更小众的有色金属上。如今，有色金属的年总收入为6000亿美元，仅相当于中国大量进口的那些大宗原材料收入的五分之一。不过未来可能会有更爆炸性的增长。

要了解哪些大宗商品生产国将在绿色转型中胜出或落败，我们构建了一个简单的场景，假定2100年全球变暖幅度将保持在2°C以下，展望十种“能源

相关”大宗商品在2040年的使用情况。根据一系列行业数据，我们预测三种化石燃料（石油、天然气、煤炭）和七种金属（铝、钴、铜、锂、镍、银和锌）的需求和收入，它们都是打造电力经济的关键商品。我们假设价格保持在今天的高位，矿业公司会因此开采未开发的矿床，同时假设生产国在2040年的市场份额与其在已知储量中的份额一致。

我们的研究表明，到2040年，全球对能源相关资源的依赖程度将低于现在，这主要是因为风和阳光这些未来的资源是免费的。十种大宗商品的总支出占全球GDP的比例将从2021年的5.8%下降到3.4%。化石燃料支出占全球GDP的比例将下降一半（如果不考虑天然气，占比还会进一步萎缩）。绿色金属的收入仍然相对较少，但占GDP的比例将从0.5%上升到0.7%。绝对值几乎增加了两倍。

能源相关大宗商品的生产大国数量将会逐渐下降。到2040年，销售额占GDP比例超过5%的生产国将有48个，少于2021年的58个（见图表2）。在这类商品上的总支出有一半以上将流入专制国家。

根据从现在到2040年间十种能源相关大宗商品预期的收入变化，可以将生产国分为三类。第一类是赢家，即绿色超级大国。这些电能国家包括一些富裕的民主国家。我们所研究的七种金属在澳大利亚储量都很丰富。智利拥有全球42%的锂储量和四分之一的铜矿，其中大部分位于阿塔卡马沙漠（Atacama，见上图）。其他是专制和威权国家。刚果拥有全球46%的钴储量（目前产量占全球70%）。中国盛产铝、铜和锂。亚洲和拉丁美洲较贫穷的民主国家也可能成为赢家。印尼坐拥大量镍矿。秘鲁有全球近四分之一的银储量。

第二类是大宗商品收入将持平或略微下降的国家，其中包括伊朗、伊拉克和沙特阿拉伯在内的低生产成本的欧佩克成员国以及俄罗斯。尽管石油收入将减少，但它们的收入份额将从现在的45%扩大到2040年的57%。美国、巴西和加拿大等其他国家虽然失去了化石燃料收入，但仍有大量金属矿藏可开采。

生产成本较高的产油国输得最多。北非（阿尔及利亚、埃及）、撒哈拉以南非洲（安哥拉、尼日利亚）和欧洲（英国、挪威）的许多储油国收入都将萎缩。南苏丹、东帝汶和特立尼达等小国的收入将遭受重创。一些海湾国家也不能幸免，例如巴林和卡塔尔的收入将减少五分之一或更多。

有什么因素可能阻碍新的大宗商品超级大国崛起？关键在于资本支出。据IEA估计，在过去十年中投产的主要矿山平均耗时16年才建成。若要满足到2040年的旺盛需求，采矿业现在必须大力投资新项目，这需要巨额资金。咨询公司伍德麦肯兹（Wood Mackenzie）的朱利安·凯特尔（Julian Kettle）估计，到2040年，必须在绿色金属勘探和生产方面支出2万亿美元。最近的矿山项目表明，仅为开采足够满足需求的铜和镍，就需要在本个十年的中后期达到2500亿至3500亿美元的资本支出。

| 加速开发

一些公司已经开始做出投资。矿业公司英美资源集团（Anglo American）计划到2030年将其铜产量提高50%至60%。“我们会做好我们该做的事。”集团老板马克·库蒂法尼（Mark Cutifani）说。其他许多公司则不会增产。受2010年代中期大宗商品崩盘的影响，矿业巨头已经减少了投资。据投资银行Liberum Capital计算，2014年以来，铜勘探与生产的年资本支出已下降一半，至140亿美元。随着价格上涨，利润也会上涨。但现金是返还给了投资者，而不是用于再投资。“供应增长几乎成了一个说不得的词。”风险投资公司Pala Investments的斯蒂芬·吉尔（Stephen Gill）说。

只有中国在大手笔投资。在刚果钴矿带上的科卢韦齐（Kolwezi），赤脚的孩子们跟所有外国人打招呼都是喊“你好”。中国公司已经拿下这里大部分的大型商业矿山。手工采矿者阿尔伯特·阿贝尔（Albert Abel）抱怨说，中国公司也买下了大多数小矿山。勇于冒险的瑞士贸易商嘉能可（Glencore）是唯一一家在刚果立足的西方公司。在印度尼西亚，中国矿业公司正在砍伐大片热带雨林以开采镍矿。

资本支出枯竭是因为三大难题——采矿业财力有限、投资回报减少和政治风险上升。先从财力说起。尽管矿业公司在未来20年内必须支出的费用仅

相当于正常情况下四年的石油勘探与生产资本支出，但似乎仍然超出了这个规模相对较小的产业的承受力。即使是大型矿业公司一次也只能投资一个大型项目。

大型矿业公司的公开市场投资者通常都比较谨慎，求助于其他资本提供方也许能解决资金问题。其中可能包括依赖稀缺矿产的垂直整合制造商。电动汽车制造商特斯拉已承诺收购澳大利亚、明尼苏达州和新喀里多尼亚（New Caledonia）矿山未来的镍产量。私募股权公司和有政府支持、负有确保供应之责的国家龙头企业也可以参与投资。

第二个问题是矿床质量恶化。乌多坎矿山称自己可能是最后一个矿石中铜含量超过1%的铜矿。智利铜矿的平均品位在过去15年中下降了30%，跌至0.7%。低品位正在推高开采和加工成本（还有碳排放）。“生产同等重量的铜，今天所消耗的能源是100年前的16倍多。”库蒂法尼说。

创新可能会有所帮助。去年，另一家矿业公司必和必拓（BHP）和挪威国家石油公司（Equinor）投资了一家人工智能创业公司，它在2000万页国家和科学档案中探查可能存在新矿藏的地点。一旦技术在未来取得突破，甚至还能让海底探矿变得有利可图。全球6.7万公里长的中洋脊含有大量的铜、钴和其他矿物。这也可能造就电能国家，斐济（8%）和挪威（5.5%）对这些中洋脊拥有最多的经济开发权。

但创新也让未来的回报不那么明朗。矿业公司需要价格持续高企才会做出投资，而这将鼓励大买家寻找最昂贵金属的替代品。特斯拉的电池中钴含量不到5%，而几年前高达三分之一。创新还可以促进回收利用。IEA估计，到2040年，从旧电池中提取钴可以帮助满足总需求的12%。

| 矿石游戏

也许投资的最大风险来自政治。矿产热势必将让一些贫穷经济体一夜暴富。几个世纪以来，包括化石燃料热潮在内的大宗商品繁荣故事表明，这种天赐资源也可能是一种诅咒，继而可能阻碍进一步的投资。

巨额石油租金让许多国家变得不稳定。敌对派系争夺资源控制权，加剧了

不平等和冲突。大量美元流入推高了当地货币，压垮了出口商。繁荣时期的债务狂潮在周期转向时引发财政危机。民众怨声载道，让国内政局更加不稳。以尼日利亚为例。1965年，该国出口的大宗商品从可可到锡多达十种。在发现石油的二十年后，石油在其商品出口中占到了97%，并引发了政治动荡。

现在的担忧是历史会重演。一些产能国家没有能力来管理天降横财。全球96只与大宗商品挂钩的主权财富基金中，大多数都以化石燃料的收入为后盾。据数据供应商Global SWF称，只有七家绿色金属出口国设立了应急基金。然而这类基金很有必要：预计对这些金属的大部分支出将发生2050年之前，此后需求将下降，出口国的日子可能就没那么好过了。

即便只是有发财的前景而已，也可能会鼓动政府从企业那里榨取更多租金。已经出现了一些紧张拉锯。世界第二大矿业公司力拓（Rio Tinto）唯在同意免除蒙古政府24亿美元的债务之后，才得以在该国重启了一个长期搁置的项目。今年1月，在一个大型锂矿计划遭到抗议之后，塞尔维亚撤销了力拓的勘探许可证。秘鲁新任左翼总统正在考虑提高税收，该国最大的铜矿之一已被要求分享利润的当地人封锁了数周。要制定新宪法的智利正在讨论将铜矿和锂矿国有化。

这种变化无常的环境显示，金属价格可能还需要冲得更高才能让外国公司认为值得一搏。迄今为止，价格上涨已经把一些西方矿业公司送上征程，前往那些曾被认为过于危险而不宜涉足之地。3月20日，加拿大公司巴里克黄金（Barrick Gold）签署了一项协议，将对巴基斯坦与伊朗和阿富汗交界处的一座铜矿投资100亿美元。必和必拓重返非洲，将在坦桑尼亚投资。

但价格可能还不够高。去年，时任嘉能可老板伊万·格拉森伯格（Ivan Glasenberg）曾表示，要真正刺激新的供应，铜价可能必须从现在每吨1万的历史高点再升至每吨1.5万美元。然而，价格越高，就越可能抑制需求，或者让当地政局更加动荡。两者都可能导致投资再度停滞。

许多可能成为绿色巨人的国家知道它们可以帮助避免气候灾难。“如果停止采矿，我们就不能减排了。”智利前能源部长胡安·卡洛斯·乔贝特（Juan Carlos Jobet）说。然而，为了发挥超级能源大国的超能力，它们将需要打破诅咒。





Geopolitics and energy

Why energy insecurity is here to stay

The war will speed the shift from petrostates to new electrostates

ENERGY AND commodities lie at the dark heart of Vladimir Putin's regime and the threat it poses to the world. Four trillion dollars of oil and gas exports over the two decades of his rule have paid for the tanks, guns and Grad missiles now killing Ukrainians. Natural-resource earnings have entrenched a rent-seeking elite that has created an offshore archipelago of yachts, nightclubs and Caribbean front companies, stifled representative politics and indulged Mr Putin's megalomaniacal fantasies.

As Russia supplies 10-25% of the world's oil, gas and coal exports, many countries, especially in Europe, are vulnerable to coercion by it. For them, the war in Ukraine has been a shock that adds urgency to the creation of an energy system which depends more on sun, wind and nuclear reactors than on derricks and rigs. Yet don't fool yourself that this new era will allow an easy escape from the curse of energy crises and autocrats.

Weeks of chaos in energy markets are beginning to hurt consumers. Petrol prices in Los Angeles are over \$6 a gallon for the first time. As sanctions on Russia bite, traders predict, Europe will run short of diesel. Germany is preparing to ration natural gas next winter, in case Russia cuts off supplies. In Asia, oil importers are bracing for a balance-of-payments hit. In a tight market, shocks are hard to absorb. Oil spiked at \$122 per barrel late last month after a pipeline from Central Asia to the Black Sea suffered storm damage and Iranian-backed Houthi rebels attacked Saudi energy facilities.

The immediate reaction of governments everywhere has been to scramble to find more fossil fuels, however polluting to the environment or painful to their pride. With Western encouragement, Saudi Aramco, the world's

biggest oil firm, is raising investment to \$40bn-50bn a year. At one point, the Biden administration buttered up Nicolás Maduro, Venezuela's dictator, perhaps to get more oil from a state which in 2005 supplied 4% of the world's crude.

The longer-term question being asked by many is: how fast can they abandon fossil fuels altogether? The energy strategy announced last month by the EU envisages independence from Russia by 2030—in part by finding new sources of gas, but also by doubling down on renewables. As the folly of relying on Russia becomes clear, nuclear power is back in fashion. France plans to construct six new plants and is aiming for “total energy independence”. On March 21st Britain said it would build a new generation of reactors at “warp speed”. A redesigned energy system that will belch out less carbon also promises an escape from the 20th century's great game of relying on energy from despots.

Yet although geopolitics will hasten the climate-driven energy transition, they will not make it risk-free. The transition will disrupt some economies and cause new dependence on others. To gauge this we have simulated spending on a basket of ten natural resources, including oil and coal, and the metals used in power generation and the electrification of industry and transport. As the world decarbonises, spending on this basket will fall from 5.8% of GDP to 3.4% by 2040. Yet in our simulation over half of that will still go to autocracies, including new electrostates that provide green metals such as copper and lithium. The top ten countries will have a market share of over 75% in all our minerals, which means production will be dangerously concentrated.

Two problems therefore stand out. First, the geopolitics of shrinking the oil industry are fraught. As Western firms withdraw for environmental reasons and in response to high costs, the market share of OPEC plus Russia will rise from 45% to 57% by 2040, giving them more clout. Higher-cost

producers such as Angola and Azerbaijan face a shock as they are squeezed out. The world map will be peppered with distressed ex-petrostates.

Second, the emerging electrostates face their own battle with the resource curse. Spending on green metals will surge amid a two-decade-long build-out of electric infrastructure. The windfall may be worth over \$1trn a year by 2040. Some beneficiaries, such as Australia, are well-equipped to deal with this. More fragile states, including Congo, Guinea and Mongolia, are not. Mountains of cash distort economies and feed grievances. Mining was a source of discord in recent elections in Chile and Peru. Global mining firms are nervous that their property rights will be buried. A resulting lack of investment has sent the price of a basket of green metals up by 64% in the past year. All this is compounded by China, which is hunting for the same resources, but is more tolerant of bad governments.

As with all commodities, soaring prices will eventually trigger a market response. Tight supply gives firms a huge incentive to step up recycling and to innovate. New kinds of small-scale nuclear reactors are emerging. Tesla, which uses minerals to make electric cars, is developing new battery designs. It has also struck a supply deal with New Caledonia, a Pacific territory of 277,000 people you will hear more about because it has a tenth of the world's nickel reserves. Last month Barrick, a Canadian firm, took a deep breath and agreed to develop a \$10bn copper mine in Pakistan.

| *High-voltage rewiring*

Yet even as markets respond, governments must also redouble their efforts. Because self-sufficiency is rarely an option, diversification is the goal. That means new partnerships. On March 20th Germany began talks with Qatar for gas. The invigoration of the rich world's nuclear industry is key, not least because it frees everyone else from relying on Chinese and Russian technology. Governments must catalyse mining investment. Firms should not be free to blow up sacred caves or endanger workers, but the transition

requires more mining projects in high-risk countries at a cost to the local ecology. Governance rules in wealthy countries need to acknowledge the trade-off. Finally, rich-world governments should help electorates prepare by, for example, helping design model contracts for a fair split of revenues and establishing sovereign-wealth funds to save the bounty.

Building a cleaner and safer energy system is an epic, risky and daunting task. But whenever resolve flags, ask yourself: would you rather rely on Mr Putin's Russia? ■



【首文】地缘政治与能源

为何能源不安全将持续下去

俄乌战争将加速影响力从石油国家向新兴电能国家转移

能源和大宗商品是普京政权及其对世界的威胁的暗黑核心所在。在普京统治的二十年里，石油和天然气出口带来了四万亿美元的收入，为如今杀害乌克兰人的坦克、枪支和“冰雹”火箭炮提供了资金。自然资源收入养肥了俄罗斯的寻租精英阶层，他们创造了一个由游艇、夜总会和加勒比海的幌子公司组成的离岸乐园，扼杀代议制政治，纵容普京的自大狂妄想。

由于俄罗斯供应了全球10%至25%的石油、天然气和煤炭出口，许多国家，尤其是欧洲国家，很容易受制于俄政府的胁迫。乌克兰战争对这些国家是一记猛击，让它们越发急切地要建立更依赖太阳、风和核反应堆而非油井和钻机的能源系统。但别以为进入这样的新时代就能轻松摆脱能源危机和独裁者的诅咒。

能源市场上持续数周的混乱已开始伤害到消费者。洛杉矶的汽油价格首次突破每加仑六美元。交易员预测，随着对俄制裁的影响显现，欧洲将出现柴油短缺。德国正准备在下一个冬天实行天然气配给制，以防俄罗斯切断供应。在亚洲，石油进口商面临国际收支平衡危机。在市场吃紧的情况下，冲击很难被吸收。从中亚通到黑海的一条输油管道最近因风暴受损，加上伊朗支持的胡塞叛军袭击沙特的能源设施，上月下旬油价飙升至每桶122美元。

世界各地政府的第一反应是一拥而上争抢更多化石燃料，把污染环境的顾虑和颜面都抛在一边。在西方的鼓励下，全球最大的石油公司沙特阿美把投资提高至每年400亿至500亿美元。拜登政府一度主动接触委内瑞拉的独裁总统马杜罗，也许是为了从这个曾在2005年供应了全球4%的原油的国家获取更多石油。

许多人提出了更长远的问题：多快能完全放弃化石燃料？欧盟上月宣布的

能源战略预计到2030年摆脱对俄罗斯的能源依赖，一部分要靠找到新的天然气供应源，一部分靠加倍投入开发可再生能源。随着欧洲国家越发意识到依赖俄罗斯供应能源实属愚蠢，核电重新走俏。法国计划建造六座新核电厂，目标是实现“完全能源独立”。3月21日，英国表示将以“神速”建造新一代反应堆。一个重新设计的能源系统不但能减少碳排放，也让欧洲有望摆脱20世纪那种依赖独裁国家提供能源的大博弈。

然而，尽管地缘政治将加快由气候驱动的能源转型，但并不会完全消除风险。转型会让一些经济体受到干扰，还会形成对其他经济体的新的依赖。为衡量这种影响，我们对十种自然资源的支出做了模拟计算，包括石油和煤炭，还有用于发电以及工业和交通电气化的金属。随着世界脱碳，到2040年，上述一篮子资源的支出将从占GDP的5.8%下降到3.4%。但我们的模拟计算显示，超过一半的支出仍将流向专制国家，包括提供铜和锂等绿色金属的新兴电能国家。对于纳入模拟计算的所有矿物，排名前十的国家将拥有超过75%的市场份额，意味着生产过于集中，形成风险。

两大问题就此突显。首先，石油工业收缩造成的地缘政治格局危机重重。随着西方石油公司因环境考量和高成本而抽身，到2040年，欧佩克和俄罗斯的合计市场份额将从45%上升到57%，让它们的影响力进一步增强。安哥拉和阿塞拜疆等产油成本较高的国家因被挤出市场而面临冲击。世界地图上将处处是陷入困境的前产油国。

其次，新兴电能国家也要面对自己的资源诅咒。在大兴土木发展电力基础设施的二十年中，这些国家在绿色金属上的支出将激增。到2040年，这笔意外之财可能达到每年一万亿美元以上。澳大利亚等一些受益国有充分的能力应对，而刚果、几内亚和蒙古等更多弱国则不然。大量资金涌入会扭曲经济，并滋生不满情绪。在智利和秘鲁最近的选举中，采矿业成了分歧的来源。全球矿业公司担心自己的产权会被剥夺。由此导致的投资不足已令一篮子绿色金属的价格在过去一年里上涨了64%。这一切又因中国而变得更加复杂，中国也在寻求这些资源，但对不良政府更加宽容。

和所有大宗商品一样，价格飙升最终会引发市场反应。供应紧张极大地刺

激了企业扩大回收再利用并寻求创新。新型的小规模核反应堆应运而生。使用矿物制造电动汽车的特斯拉正在开发新的电池设计，并与27.7万人口的新喀里多尼亚达成了一项供应协议——你以后会更多听到这个南太平洋法国属地的名字，因为它拥有全球十分之一的镍储量。上月，加拿大的巴里克黄金公司（Barrick）鼓足勇气，同意在巴基斯坦开发一个价值100亿美元的铜矿。

| 重布高压线

然而，在市场做出回应的同时，政府也必须加倍努力。由于很难做到自给自足，多样化才是目标。这意味着要建立新的伙伴关系。3月20日，德国开始与卡塔尔展开天然气谈判。富国振兴核工业是关键，尤其是因为这可以使其他国家摆脱对中国和俄罗斯技术的依赖。政府必须促进矿业投资。矿业公司不应随意炸毁神圣洞穴或罔顾工人安全，但能源转型需要在高风险国家开展更多采矿项目而付出损害当地生态环境的代价。富裕国家的治理法则需要承认这种取舍。最后，富裕国家政府应帮助电能国家做好准备，例如帮助它们设计公平分配收入的合同模板，并建立主权财富基金来存储收益。

建成一个更清洁安全的能源系统是漫长艰巨又冒险的任务。但每当决心动摇时，问问自己：你宁愿去依赖普京的俄罗斯吗？ ■



The Economist Film

NFTs - Are they worth the hype? (Trailer)

Are NFTs just overpriced digital arts, or a promising technology that could transform the way we live?



经济学人视频

NFT热潮是泡沫吗？（预告）

NFT究竟是价格虚高的数字艺术，还是有潜力颠覆我们生活方式的技术？



WeBinged

Why the WeWork fiasco makes for compelling TV

“WeCrashed” turns a corporate tale into a popcultural event

SURFING BETWEEN team-building exercises. Tequila shots in meetings and pot on private jets. Barefoot strolls around New York. Adam Neumann’s quirks have been familiar to readers of newspapers’ business pages since 2019, when WeWork, the workspace provider with tech aspirations that he co-founded, reached a private valuation of \$47bn, only to crumble after an abortive initial public offering (IPO). The story of WeWork and its flamboyant boss have now reached a wider audience thanks to “WeCrashed”, a new series which will stream on Apple TV+ from March 18th.

Popular culture, whose creators lean left, revels in skewering the perceived greed of capitalism, also through the prism of real-life business figures. The villains change with the times. In the 1990s it was the buy-out barons (“Barbarians at the Gate”). After the financial crisis of 2007-09 it was the investment bankers (notably on stage with “The Lehman Trilogy”) and other financiers (on the silver screen with “The Big Short”). As big tech grew too big for some tastes, the spotlight turned to its misanthropic billionaire bosses (“Steve Jobs”, “The Social Network”).

The latest cohort of capitalist anti heroes and -heroines to receive popcultural treatment includes the darlings of Silicon Valley’s startup scene. “The Dropout”, a series streaming on Hulu and Disney+, recounts the rise and fall of Elizabeth Holmes and her fraudulent blood-testing firm. Showtime’s “Super Pumped” dissects the life of Travis Kalanick, Uber’s brilliant but abrasive co-founder. “WeCrashed” belongs to this genre.

Mr Neumann and his new-agey wife, Rebekah (“fear is a choice”), are made

for TV. Most chief executives have big egos but few can match the sheer scale of the couple's narcissism (or good looks). Mr Neumann, who grew up in an Israeli kibbutz, once claimed that the elusive Middle East peace treaty would be signed at a WeWork venue. His company's IPO prospectus promised not merely to offer convenient co-working space but, apparently without irony, to "elevate the world's consciousness". Portrayed masterfully by Jared Leto and Anne Hathaway, the on-screen Neumanns are, like many startup founders only more so, both intoxicating and painful to watch. It is suddenly easy to understand why so many investors felt at once besotted and uncomfortable around them.

Mr Neumann's knack for distorting reality—most notably by dressing up a loss-making office-rental firm as a successful tech giant—is a trait common to many successful founders. It is not the whole story, however.

"WeCrashed" also depicts how the reality of Silicon Valley distorted him and his firm. In one scene Son Masayoshi, the messianic boss of SoftBank, a free-spending Japanese tech-investment group that poured billions into WeWork, tells Mr Neumann, "You're not crazy enough." A string of other prominent venture capitalists likewise encouraged the company to aim for the stars. So it did.

Colourful characters aside, WeWork's rise and fall makes for compelling TV because it follows the dramatic arc of a Greek tragedy: a protagonist grossly overestimates his abilities; his hubris is punished; order is restored. Except in this case, the punishment is meted out not by mercurial gods but by Mr Neumann's increasingly impatient VC backers and the public markets, whose scrutiny of his firm's value-torching business model undid the IPO. As such, "WeCrashed" also traces the arc of capitalism's capacity for self-correction. ■



我们煲剧

为什么WeWork的惨败能拍成扣人心弦的剧集

《初创玩家》把一家公司的兴衰史变成一起流行文化事件

在团建活动的间隙冲浪，在开会时喝龙舌兰酒，在私人飞机上抽大麻，在纽约光着脚晃荡。自2019年以来，报纸商业版面的读者已经很熟悉亚当·诺伊曼（Adam Neumann）的各种怪异行为了。那一年，他联合创办的一心想成为科技公司的工作空间供应商WeWork在私人市场的估值达到470亿美元，却在IPO失败后轰然倒塌。3月18日，Apple TV+上线了新剧集《初创玩家》，WeWork和它这位浮夸老板的故事将因此更加广为人知。

由偏左翼人士创造的流行文化热衷于尖锐讥讽“资本主义的贪婪”，而这本身也是透过真实的商界人物这一棱镜所获的观感。这些反派人物与时俱进地改头换面。上世纪90年代他们是收购大亨（参见《门口的野蛮人》一书）。在2007至2009年的金融危机之后，他们变成了投资银行家（尤其是话剧《雷曼兄弟三部曲》里的人物）和其他金融家（电影《大空头》里的角色）。随着大型科技公司规模越来越大而引起了一些反感，聚光灯又转向了性情乖僻的亿万富翁大老板（电影《史蒂夫·乔布斯》和《社交网络》）。

最新一批接受流行文化注目礼的资本主义反英雄包括硅谷创业界的宠儿。在Hulu和Disney+上播放的美剧《辍学生》（The Dropout）讲述了伊丽莎白·福尔摩斯（Elizabeth Holmes）和她那欺世盗名的验血公司的兴衰。Showtime播出的《热血野心》（Super Pumped）剖析了优步才华横溢但生硬粗鲁的联合创始人特拉维斯·卡兰尼克（Travis Kalanick）的人生。《初创玩家》也属于这一类题材。

诺伊曼和他新世纪范儿的妻子丽贝卡（Rebekah）（她曾对丈夫说“恐惧是一种选择”）简直就是为电视而生。大多数高管都自视甚高，但很少有人能与诺伊曼夫妇的自恋程度相提并论（外貌也比不上）。在以色列集体农场长大的诺伊曼曾声称，迟迟难以达成的中东和平条约将在WeWork的某

个办公场地签署。他公司的招股说明书不仅承诺提供便捷的共享办公空间，还一本正经地声称要“提升世界的意识”。电视剧里的诺伊曼夫妇被贾里德·莱托（Jared Leto）和安妮·海瑟薇（Anne Hathaway）演绎得惟妙惟肖，即令人着迷又难以直视——就和许多创业公司的创始人一样，只不过程度更甚。突然间你很容易就理解为什么这么多投资者在他们身边会感到既痴迷又不安。

诺伊曼扭曲现实的本事是许多成功创始人的共同特征，他在这方面最出名的就是把一家亏损的办公室租赁公司包装成一个成功的科技巨头。然而，这并不是这部电视剧的全部内容。《初创玩家》还描绘了硅谷的现实如何扭曲了诺伊曼和他的公司。有这样一幕，一向大肆挥霍、往WeWork砸了十几亿的日本科技投资集团软银救世主般的老板孙正义对诺伊曼说，“你还不够疯”。多个知名风投家也都鼓励WeWork志存高远。它也确实照做了。

抛开多姿多彩的人物不谈，WeWork的兴衰故事本就是很好的电视剧素材，因为它的情节是沿着希腊悲剧的戏剧性弧线展开的：主角严重高估了自己的能力，他的狂妄自大受到了惩罚，秩序得到恢复。只不过在现实中，施以惩罚的不是喜怒无常的神，而是诺伊曼那些越来越不耐烦的风险投资者和公开市场，他们对这家公司自毁价值的商业模式的盘查令IPO计划告吹。因此，《初创玩家》同时也勾勒出了资本主义自我纠正能力的弧线。■



Private credit

More borrowers turn to private markets for credit

Asset managers rush in where banks fear to tread, transforming a formerly niche market

AS HE ASCENDED the hierarchy of corporate finance in the 1980s to become king of junk bonds, Michael Milken stood out. Not least physically: he paced the trading floor of Drexel Burnham Lambert sporting a lush but ill-fitting wig. More than 30 years on, junk bonds are a recognised part of the market for raising capital. So are other innovations spawned by the buy-out barons, such as collateralised loan obligations (CLOs), securities into which leveraged loans are packaged. Fast gaining ground on these debt markets is one for private credit, which may now be causing more excitement than any other private market.

Before the financial crisis, private credit was a niche pursuit, consisting of distressed debt and “mezzanine” finance (a risky segment between debt and equity). Over the past decade it has spread to activities ranging from aircraft leasing to “direct lending”, or loans to small and mid-size companies without using a bank or securities firm. PE firms are cutting out banks and borrowing from direct lenders, including each other’s credit arms, to fund buy-outs. Banks huff at this loosening of their grip on financing PE deals that used to be backed by their loans or junk bonds.

The private-credit market has more than doubled in size since 2015 and is now worth at least \$1trn worldwide, not far off the \$1.3trn institutional loan market, says Moody’s. The BIS reckons it may be closer to \$1.5trn. Private credit has at times recently exceeded junk-bond issuance, itself at record levels. Transaction sizes have risen commensurately. “Fifteen years ago the biggest deals were a few hundred million dollars. Now they’re four or five billion,” says Michael Arougheti, boss of Ares Management.

Ares is one of several firms dominating the market. Others include Apollo, Blackstone and Brookfield. Ares sought to raise a \$4.5bn credit fund last year. So strong was demand that it closed at \$8bn. Debt specialists are among the private markets' hottest assets. Brookfield bagged one of the most sought-after in 2019, paying \$4.7bn for a majority stake in Oaktree Capital. Mainstream fund managers are also gaining a foothold: credit accounts for around half of BlackRock's \$320bn alternatives business.

The market has been propelled by two big forces. One is the retreat of banks, leaving a void for non-banks. This began in the 2000s as banks looked to trim inventory and go back to being agents, not principals. It accelerated after the financial crisis as banks were forced by tougher capital requirements to offload risky assets. The second is the ubiquitous search for yield. Private credit offers juicier returns than mainstream fixed income. Rock-bottom rates have "pushed ever more investors into a liquidity-for-yield exchange", says Jean-Marc Chapus, the co-founder of Crescent Capital.

In America, banks' share of lending to small and mid-size firms has fallen from around 30% to 20% since 2010, reckons Moody's. Banks have also backed off property lending, particularly for construction and refurbishment, for which regulated lenders have been hit with steep capital charges. Spurred by accounting changes, banks across Europe have marked down dud property loans. Private-debt funds are snapping these up at 50-60 cents on the euro, rewriting loan covenants and, where necessary, offering borrowers fresh liquidity, says Stuart Fiertz of Cheyne Capital, an alternative asset manager.

They have also been busy in markets that emerged from the wreckage of the securitisation meltdown of 2008, conjuring deals for speciality-finance companies in equipment leasing, consumer lending and receivables financing. Apollo has bought two car-leasing firms, a provider of home-

improvement loans and a commercial-mortgage lender with a clean-energy focus.

Private credit gives investors more options in the middle ground of risk, between staid bonds or syndicated debt and racy private or growth equity. Expected annual returns range from 4% to the low teens, depending on the product. Both fees and the risk of an investment flopping are lower than with buy-outs. Investors with explicit return targets, such as pension funds, are understandably tempted by coupons of 8-10% or more. Scott Kleinman, co-president of Apollo, says such long-term capital is a good fit for private credit. "I tell them they're the long-term lenders of the future."

For borrowers, the attraction is availability: smaller companies can't easily access public or syndicated debt markets. Others value negotiating contracts more closely tailored to their needs than is possible in other markets, or the fact that direct lenders can move quickly and also be more forgiving of defaults. Some borrowers use the market to avoid disclosure required in public debt markets. For credit funds, an attraction is the promise of excess return for illiquidity or, as Marc Rowan, Apollo's boss, puts it, "complexity and origination". At a big enough scale, making a spread of a single percentage point over public markets is enough for a healthy return. "Five years ago our credit business was mostly high-octane distressed debt and special situations," says Jonathan Gray at Blackstone. Now the firm is doing more, ranging from corporate-loan deals to "steadier yield products" such as property funds that yield less (say, 5-6% a year) but have the potential to be sold "at massive scale".

On the market's lower rungs there is space for specialists to carve out niches. A number of smaller players offer credit facilities with "ratchets". These give borrowers a discount on interest rates (typically up to 0.25 percentage points) if they meet certain targets. Tikehau Capital, a Europe-focused asset manager, has arranged "ESG ratchets" for more than 20 loans,

linked to goals ranging from renewable-energy use to reducing work accidents.

Not everyone sees the market's growth as an unalloyed good. In a report last October Moody's called it an opaque, less regulated "grey zone" with low liquidity and hidden leverage. Lenders claim defaults are lower than on institutional loans, but disclosure is thin and definitions of default inconsistent. As with junk bonds, covenants that protect creditors if borrowers get into trouble are being weakened as competition grows. Dan Rasmussen of Verdad Capital says the market has been lending to small tech firms based on flaky projected revenues.

| *Moody's blues*

The BIS recently analysed the growth of private markets, highlighting benefits but dwelling more on risks. Agustín Carstens, the BIS's general manager, called for more comprehensive, systemic regulation of non-bank lending. Regulators are looking at what Christina Padgett of Moody's calls "networks of collaboration" in private credit: the market is dominated by a small number of asset managers with overlapping interests. This raises questions about conflicts of interest and poorly understood risk transmission, yet to be tested by a full default cycle. Links between lenders and borrowers add further complexity. Apollo owns around 100 of the 5,000 firms with which it has a financial relationship.

"I could go back 20 years and show you the same doom-laden reports," says Mr Arougheti. Before covid, he says, private credit was seen as the next shock. But nothing happened amid the tumult of spring 2020. The big private-market players were, if anything, a stabilising influence: many stayed in the game even as liquid markets briefly seized up. Few were forced sellers. "Private-credit funds and private-equity owners did a lot of bespoke rescue financing and other patching up, often in tandem," says Ramya Tiller of Debevoise & Plimpton, a law firm.

After the breakneck growth of the past few years, a pause or correction seems inevitable. For now, though, funds and their advisers are planning on a busy first half of 2022, with numerous credit mega-funds in the works. Some wonder if there will be enough borrowers to absorb the capital flowing in.

The big funds brush off talk of tighter market conditions. “The two things that drive investors to credit are volatility and higher rates,” says Holcombe Green, at Lazard. If both materialise, money may flow into private credit from buy-outs and growth equity, he suggests. Most private credit is floating-rate, making it less vulnerable to the interest-rate risk of traditional fixed income.

Ares expects its overall business, two-thirds of which is credit, almost to double by 2025. Apollo thinks its credit business could double over the next five years. “People say that private credit’s addressable market is \$5trn-10trn,” says Jim Zelter, Apollo’s co-president. “We think it could be much bigger than that, if it also takes in swathes of the mortgage markets, trade and inventory finance and the like.” Add in “fixed-income replacement” products, less-risky credit offering returns in the 3-8% range, and the market could be \$40trn, he says. As in all private markets, the bet is that greater scale will more than offset lower returns. ■



私人信贷

更多借款人转向私人市场寻求信贷

资产管理公司涌入银行不敢涉足的领域，改变了一个先前的利基市场【专题《私人市场》系列之四】

在1980年代，迈克尔·米尔肯（Michael Milken）可谓脱颖而出——他在公司金融领域平步青云，成为垃圾债券之王。在外表方面也是如此：他戴着一顶华丽但不合身的假发在德崇证券（Drexel Burnham Lambert）的交易大厅里踱步。30多年过去了，垃圾债券已成为融资市场公认的一部分。收购巨头催生的其他创新也是如此，例如贷款抵押债务（CLO），即打包杠杆贷款的证券。在这些债务市场上迅速抢占地盘的是私人信贷市场，它现在可能比任何其他私人市场都更令人兴奋。

在金融危机之前，私人信贷是一种小众追求，包括不良债务和“夹层”融资（介于债务和股权之间的一个有风险的做法）。在过去的十年里，它已经扩展至涵盖从飞机租赁到“直接贷款”，即在不借助银行或证券公司的情况下向中小企业发放贷款。私募股权公司正在绕过银行，并从包括彼此的信贷部门在内的直接贷方借款来资助收购。由此失去对私募股权交易融资的控制让银行恼怒不已，这些交易过去是用银行贷款或垃圾债券支持的。

穆迪表示，自2015年以来，私人信贷市场规模扩大了一倍多，目前在全球范围内至少价值1万亿美元，与1.3万亿美元的机构贷款市场相差不远。国际清算银行（BIS）估计它可能接近1.5万亿美元。最近，私人信贷有时甚至超过垃圾债券的发行量，而后者本身就达到了创纪录的水平。交易规模也相应增加。“十五年前，最大的交易是几亿美元。现在则是四五十亿。”阿瑞斯投资（Ares Management）的老板迈克尔·阿罗盖蒂（Michael Arougheti）说。

阿瑞斯是主导市场的几家公司之一，其他包括阿波罗、黑石和博枫（Brookfield）。去年，阿瑞斯寻求筹资成立45亿美元的信贷基金。需求是如此强劲，以致最后募集了80亿美元。债务专家是私人市场最热门的资

产之一。博枫成为2019年最受欢迎的公司之一，斥资47亿美元收购了橡树资本（Oaktree Capital）的多数股权。主流基金经理也分到一杯羹：在贝莱德3200亿美元的另类投资业务中，信贷约占一半。

市场受到两大力量的推动。一是银行撤退，给非银行留下空白。这始于2000年代，当时银行希望削减库存并重新成为代理方，而不是当事方。金融危机后，由于资本要求趋严，银行被迫出售风险资产，导致这一趋势加速。二是对收益无处不在的搜寻。私人信贷提供比主流固定收益更高的回报。新月资本（Crescent Capital）的联合创始人让-马克·查普斯（Jean-Marc Chapus）表示，处于谷底的低利率“推动越来越多的投资者以流动性换收益”。

穆迪估计，自2010年以来，在美国，银行占对中小企业贷款的份额已从30%左右下降至20%。银行在房地产贷款上也有所收缩，特别是建筑和翻新方面的贷款，受监管的贷方在这些方面受到了高额资本费用的打击。在会计变化的推动下，欧洲各地的银行都减记了不良房地产贷款。另类资产管理公司奇恩资本（Cheyne Capital）的斯图尔特·菲尔茨（Stuart Fiertz）表示，私人债务基金正在以五到六折的价格抢购这些资产，重写贷款契约，并在必要时为借款人提供新的流动性。

它们在从2008年证券化崩溃的废墟里崛起的市场中也十分活跃，为特种金融公司创造设备租赁、消费贷款和应收账款融资方面的交易机会。阿波罗已经收购了两家汽车租赁公司、一家提供家庭装修贷款的公司，以及一家专注于清洁能源的商业抵押贷款公司。

私人信贷为投资者提供了更多处于风险中间地带的选择，介于稳健的债券或银团债务与刺激的私人或成长股之间。根据产品的不同，预期年回报率从4%到略高于10%不等。费用和投资失败的风险都低于收购。不出所料，具有明确回报目标的投资者（例如养老基金）会受到8%到10%或更高的息票率的诱惑。阿波罗的联合总裁席斯科特·克莱恩曼（Scott Kleinman）表示，这种长期资本非常适合私人信贷。“我告诉它们，它们是未来的长期放贷方。”

对于借款人来说，吸引力在于容易获得融资：小公司无法轻易利用公共或银团债务市场。还有人看重它比起其他市场更能够根据自己的需求定制谈判合同，或是直接贷方可以快速行动并且更宽容违约。一些借款人利用这一市场来避免公共债务市场的披露要求。对于信贷基金而言，吸引力在于承诺为非流动性提供超额回报，或者如阿波罗的老板马克·罗文（Marc Rowan）所说的“复杂性和原创性”。在足够大的规模上，拿到比公开市场高一个百分点的息差就足以获得良好的回报。“五年前，我们的信贷业务主要是高风险的不良债务和特殊工具。”黑石的乔纳森·格雷（Jonathan Gray）说。现在，该公司的业务更为广泛，从企业贷款交易到“收益率更稳定的产品”，例如收益率较低（例如，每年5%到6%）但有可能“大规模”出售的房地产基金。

在市场的较低层级上则有空间让专家们开拓利基市场。一批较小的参与者提供带有“棘轮”的信贷便利。如果借款人达到某些目标，它会给借款人提供利率折扣（通常高达0.25个百分点）。主要面向欧洲的资产管理公司提克豪资本（Tikehau Capital）为20多笔贷款安排了“ESG棘轮”，关联了从使用可再生能源到减少工伤事故等目标。

并非所有人都觉得这一市场的增长有百利而无一弊。在去年10月的一份报告中，穆迪称之为一个不透明、监管较少的“灰色地带”，流动性低，还有隐藏的杠杆。贷方声称违约率低于机构贷款，但披露很少，对违约的定义也不一致。与垃圾债券一样，随着竞争的加剧，在借款人陷入困境时保护债权人的契约正在被削弱。韦尔达资本（Verdad Capital）的丹·拉斯姆森（Dan Rasmussen）表示，市场一直在基于不可靠的预期收入向小型科技公司提供贷款。

| 穆迪的忧郁

国际清算银行最近分析了私人市场的增长，强调了好处，但更多地关注了风险。该行总经理奥古斯汀·卡斯滕斯（Agustín Carstens）呼吁对非银行贷款进行更全面、更系统的监管。监管机构正在关注穆迪的克里斯蒂娜·帕吉特（Christina Padgett）所说的私人信贷“合作网络”：市场由少数利益重叠的资产管理公司主导。这引发了关于利益冲突和人们所知甚少的风

险传递的问题，尚未经历完整的违约周期检验。贷方和借方之间的联系进一步增加了复杂性。阿波罗拥有与其有财务关系的5000家公司中的大约100家。

“我可以回到20年前，给你看同样阴云密布的报告。”阿鲁盖蒂说。他说，在新冠疫情之前，私人信贷被视为下一个冲击。但在2020年春季的动荡中什么也没发生。大型私人市场参与者，如果真要说的话，是一种稳定市场的影响：即使在流动性市场短暂失灵之时，许多人仍留在游戏中。很少有人被迫出售。“私人信贷基金和私募股权所有者做了大量的定制化救援融资和其他修补工作，而且往往是同时在做。”德普律师事务所（Debevoise & Plimpton）的拉姆雅·提勒（Ramya Tiller）说。

在经历了过去几年的飞速增长之后，停顿或修正似乎不可避免。不过，就目前而言，基金及其顾问正在筹划忙碌的2022年上半年，有众多大型信贷基金正在筹建。一些人想知道是否会有足够的借款人来吸收流入的资本。

大型基金对市场条件趋紧的说法不屑一顾。“把投资者推向信贷的两件事是波动性和更高的利率。”诺斯德（Lazard）的霍尔科姆布·格林（Holcombe Green）说。他认为，如果两者都发生，资金可能会从收购和成长型股权流入私人信贷。大多数私人信贷是浮动利率的，因此不太容易受到传统固定收益的利率风险的影响。

阿瑞斯预计其整体业务（其中三分之二是信贷）到2025年会接近翻一番。阿波罗认为其信贷业务在未来五年内可能翻一番。“人们说私人信贷的潜在市场是5到10万亿美元，”阿波罗联合总裁吉姆·泽尔特（Jim Zelter）说，“我们认为，如果再算上抵押贷款市场、贸易和库存融资等领域，可能会比这个数大得多。”他说，加上“固定收益替代”产品、回报率在3%到8%的风险较低的信贷产品，市场规模可能达到40万亿美元。与所有私人市场一样，赌注是更大的规模将足以弥补较低的回报。 ■



Into the mainstream

Private markets have grown exponentially

The past decade has been a golden one for private financial markets. As they become bigger they are being dramatically reshaped, says Matthew Valencia

WHEN JOHN CONNAUGHTON left consulting for private equity (PE) by joining Bain Capital in 1989, “my mentors counselled against it,” he recalls. “They said it wouldn’t last.” Now he heads Bain’s global PE business. He has helped assemble such huge deals as the formation of IQVIA, a life-sciences group valued at \$47bn. Bain Capital manages \$155bn of assets. The target for its 13th buy-out fund last year was \$9bn; it closed just short of \$12bn.

PE has been on a tear for three decades. Other firms set their sights even higher than Bain Capital. Blackstone, the biggest, wants to raise a record \$30bn for its next fund. CVC, Hellman & Friedman and Apollo Global Management have launched vehicles of \$20bn or more. Funds are not just bigger but also being formed more quickly. The cycle between general partners (GPs), who manage PE funds, closing one fund and starting the next has shortened from five years to half that, says David Perdue of PJT Partners, an investment bank. Institutional investors such as university endowments, sovereign-wealth funds and pension plans are increasingly keen on PE and other alternatives to public markets. The attraction is understandable: in the latest fiscal year, many large American endowments enjoyed returns of 30-60% mainly thanks to private markets.

The PE industry has been “supersizing”, says Hugh MacArthur of Bain & Company, a consultancy no longer affiliated with Bain Capital. By most measures, from fundraising to “dry powder” (committed capital awaiting deployment), it is three times larger than a decade ago. In just five years, the number of PE funds registered in America has jumped by more than half, to over 18,000.

Dealmaking is at record levels. The global value of disclosed leveraged buy-outs reached \$1.2trn in 2021, far above the previous record of \$800bn in 2006. PE made up a fifth of all mergers and acquisitions, its highest share for at least a decade. This deal splurge has supercharged activity in high-yield (junk) bond and leveraged-loan markets. Junk-bond issuance surpassed \$600bn for the first time last year. So hungry were PE funds in 2021 that the bidding process sped up dramatically. Kem Ihenacho of Latham & Watkins, a law firm, says that, just as buyers gazump when housing markets are red-hot, many bidders are “pre-empting the auction” by offering to sign less than halfway through the process.

Besides buying assets from corporate owners and founders, private funds buy from each other. Some firms have been through three or four PE funds' hands. In America, secondary buy-outs can exceed the volume of initial public offerings (IPOs), the usual route for investors to cash out, says the Bank for International Settlements (BIS), the central bankers' bank.

The PE boom is part of a broader expansion of private markets. Top-tier firms that once focused on leveraged buy-outs, such as Blackstone, KKR and Carlyle, now look just as keenly for opportunities in private debt, real assets such as property and infrastructure, and “growth equity”, which sits between venture capital and buy-outs. More than two-thirds of the industry's dry powder is earmarked for investments other than buy-outs. Since 2010 buy-outs have gone from 80% of KKR's business to less than half.

These market leaders are now “one-stop capital providers” for firms less able to tap traditional sources such as banks and public markets, says the BIS. Such diversification (along with stratospheric pay) has cemented their reputation as the new kings of Wall Street. Today's business-school graduates may now be more likely to seek a career in private markets than in investment banking. Last year Blackstone had 29,000 applicants for just

over 100 analyst jobs.

The growth of private markets has accelerated since the financial crisis of 2007-09, outpacing public markets. At its pre-crisis peak, the private-capital industry had some \$2.2trn under management. Today it manages four to five times as much, a little over half of it in North America.

The private-markets party has boosted profits and share prices. In 2021 the industry's upper ranks posted record results, and publicly listed PE firms enjoyed benchmark-beating share-price gains. Blackstone's and KKR's share prices doubled. The average profitability of alternative managers is well above that of banks (albeit more volatile). The Boston Consulting Group reckons alternative managers took in more than 40% of global asset-management revenues in 2020.

Since taking off in the 1980s, PE has seen two boom-and-bust cycles. The first boom was driven by swashbuckling dealmakers, epitomised by KKR co-founders Henry Kravis and George Roberts. Its emblematic deal was the highly leveraged \$25bn takeover of RJR Nabisco in 1988. The first bust soon followed. The second boom, starting in the late 1990s, saw the industry scale up and expand beyond equity and outside America. Several managers, starting with Blackstone, took advantage of it to list their own shares, monetising fee income and giving GPs more exit options. More have since done so. TPG, a San Francisco leveraged-buy-out firm with some \$110bn of assets, listed on the Nasdaq in January.

| *Boom back bigger*

The financial crisis hit PE, but it bounced back, fuelled by cheap debt as interest rates fell. Even the arrival of covid-19 in 2020 did not knock it for long. Dealmaking froze briefly, but PE firms moved to shore up portfolio firms that needed help or as an opportunity to buy cheap assets. M&A activity took off again later that year.

Private markets have been propelled by push and pull factors, says Mohamed El-Erian, chief economic adviser at Allianz, an insurer, and a former boss of PIMCO, a bond-fund manager. The main push factor was ultra-loose monetary policy, which drove investors towards illiquid markets that offered higher yields. Another was the retreat of banks in response to tougher capital requirements and post-crisis laws (such as Dodd-Frank in America) that discouraged or prohibited them from betting with their own balance-sheets. Private funds gleefully took up the slack. Among pull factors are innovations such as private-debt and property-investment funds that were designed to appeal to wealthy individuals and institutions.

As private markets have grown, more young firms have chosen to delay going public. The average age of companies doing an IPO in America was eight years in the 1980s and 1990s. The average since 2001 has been 11 years. “Private equity has redefined its role as a waystation to the public markets,” says Chip Kaye, boss of Warburg Pincus, a PE firm focused on growth investing.

As companies stay private longer, “more investors are looking to get in at that pre-IPO stage, as that’s when most of the wealth creation happens,” says Ben Meng of Franklin Templeton, a fund manager. Some firms opt not to go public at all, confident of raising enough capital privately, says Byron Trott, head of BDT Capital Partners, a merchant bank for family firms. Of the 40 companies BDT has invested in since 2009, only three have gone public.

Not that the public markets are down and out. Last year was a record one for IPO listings. Firms going public also have other routes, such as direct listings or mergers with special-purpose acquisition companies (SPACs), which landed with a bump after a boom in 2020-21 but are unlikely to disappear. Yet at around 4,000, the number of publicly listed American firms is far below its peak of nearly 6,000 in the mid-1990s. One reason is

that investors see disadvantages in public ownership, including onerous disclosure requirements, quarterly earnings pressure and attacks by activist investors.

At PE-owned firms, the activists are on the inside. Owners work closely with managers to shape strategy and capital structure. They reward success handsomely while punishing failure faster than the owners of public firms. Done correctly, this can increase value by narrowing the information gap between shareholders and management, reducing agency costs. The endowments, pension funds and other institutional investors that fuel private markets are believers. They think large allocations to alternative investments offer the best hope of hitting annual-return targets for their portfolios that are typically in the high single digits.

But as the industry enters its third age, it faces challenges. One is the prospect of sustained higher inflation and interest rates. Cheap debt is PE's lifeblood. A rise of a couple of percentage points in the cost of borrowing is unlikely to lead to surging bankruptcies. But more than that might. As more capital has flowed into private markets, prices for assets have risen so far that "there is little room for error," says Bain & Company's Mr MacArthur. For buy-outs the average price tag relative to earnings is at an all-time high.

A second worry is greater scrutiny. Private markets are lightly regulated and opaque. Regulators want more transparency, especially on fees and performance measures. Supervisors want to know how private markets might affect financial stability. The industry must also navigate geopolitics, notably the reassessment of the virtues of foreign capital by China, until recently a big part of many managers' plans. The collapse in September of Blackstone's \$3bn deal to buy SOHO China, a property developer, augurs ill.

The final test comes from within: generational change. Many who shaped the industry are leaving. Mr Kravis and Mr Roberts handed over to new co-

heads last year. Stephen Schwarzman, Blackstone's 75-year-old co-founder, remains the boss, but more day-to-day responsibility rests with its 52-year-old president, Jonathan Gray. Apollo's co-founder, Leon Black, quit in March 2021 after an inquiry into his ties to Jeffrey Epstein. At Carlyle, one co-CEO quit in 2020 after losing a power struggle. Can new leaders keep the magic going? The challenge is tougher when, as Stan Miranda of Partners Capital, an investment firm, puts it, "We've been through a golden 40-year period in which conditions grew ever more benign. It's been incredible—and it may well be over."

This special report looks at the risks as the tailwinds of the past decade drop, and at the opportunities as private markets win new investors. It considers a future in which scoring big with buy-outs is no longer enough. It explores what institutional investors want and the burgeoning market for private debt; and it looks at regulatory and reputational landmines. The report focuses on America. Private markets have become more global, but it remains true that today's trend in New York is tomorrow's in London or Shanghai. ■



进入主流

私人市场呈指数级增长

专题作者马修·瓦伦西亚认为，过去十年是私人金融市场的黄金十年。随着它们扩大规模，它们也在经历翻天覆地的重塑【专题《私人市场》系列之一】

约翰·康诺顿（John Connaughton）在1989年加入贝恩资本（Bain Capital），从咨询转行去了私募。“我的导师们不建议我去，”他回忆道，“他们说它活不久。”现在他负责贝恩资本的全球私募股权业务。他帮助组建了一些巨额交易，比如成立估值470亿美元的生命科学集团艾昆纬（IQVIA）。贝恩资本管理着1550亿美元的资产。去年它的第13只收购基金的募资目标是90亿美元，最后募集了接近120亿美元。

私募股权投资已经飞速成长了三十年。其他公司的目标比贝恩资本更宏伟。其中最大的黑石集团（Blackstone）希望为自己的下一只基金募集创纪录的300亿美元。CVC、赫尔曼弗里德曼（Hellman & Friedman）和阿波罗全球管理（Apollo Global Management）已经启动了200亿美元以上的基金。基金不仅规模更大了，组建得也更快。投资银行PJT Partners的戴维·珀杜（David Perdue）表示，管理私募基金的GP（普通合伙人）从关闭一只基金到启动下一只基金之间的周期已从五年缩短了一半。大学捐赠基金、主权财富基金和养老金计划等机构投资者越来越热衷于私募股权等其他替代公开市场的投资方式。这种吸引力是可以理解的：在最近一个财年，主要受益于私人市场，美国许多大型捐赠基金获得了30%到60%的回报。

私募行业一直在“膨胀”，贝恩咨询（Bain & Company，与贝恩资本已无关联）的休·麦克阿瑟（Hugh MacArthur）表示。以大多数标准衡量——从募资规模到“干火药”（等待部署的承诺出资）——行业的规模已是十年前的四倍。在短短五年间，在美国注册的私募基金数量猛增超过一半，达到18000多家。

交易数量处于创纪录水平。2021年，全球已披露的杠杆收购价值达1.2万亿

美元，远高于2006年创下的8000亿美元的历史记录。私募占有所有并购交易的五分之一，是至少十年来的最高占比。这种交易狂欢刺激了高收益（垃圾）债券和杠杆贷款市场的活动。去年，垃圾债发行首次突破六千亿美元。2021年，私募基金对交易的饥渴甚至促使竞标程序大幅提速。瑞生国际律师事务所（Latham & Watkins）的凯姆·伊希纳齐奥（Kem Ihenacho）表示，就像房地产市场火热时很多人加价挤掉原买家那样，许多竞标者在流程未过半时就愿意签字“抢先拍下”了。

除了从企业所有者和创始人那里购买资产外，私人基金之间也相互购买。一些公司已在三四只私募基金间易手。“央行中的央行”国际清算银行表示，在美国，二次收购的交易量可能超过首次公开募股（IPO）这一投资方常用的变现途径。

这轮私募繁荣是更大范围的私人市场扩张的一部分。曾专注于杠杆收购的顶级公司，如黑石、KKR和凯雷（Carlyle），现在同样热衷于在私人债务、房地产和基础设施等实物资产，以及处于风投和收购之间的“成长型股权”中寻找机会。该行业超过三分之二的“干火药”被专门留给收购以外的投资。自2010年以来，收购已从占KKR业务的八成降至一半不到。

国际清算银行表示，这些市场领导者现在成了“一站式资本提供者”，服务那些难以利用银行和公开市场等传统资源的企业。这种业务多元化（加上支付天价薪酬）巩固了它们身为“华尔街新王”的声誉。今天的商学院毕业生可能会更多地寻求进入私人市场而非投资银行。去年，黑石的100多个分析师职位收到了2.9万份求职申请。

自2007到2009年的金融危机以来，私人市场的增长已经提速，超过了公开市场的增速。在危机前的高峰期，私人资本行业管理着约2.2万亿美元。今天它管理的资金量已经增长了四到五倍，其中略多于一半都在北美。

这场私人市场派对已经提振了利润和股价。2021年，行业佼佼者发布了创纪录的业绩，而上市私募公司的股价涨幅超过了基准水平。黑石和KKR的

股价翻了一番。另类资产管理公司的平均盈利能力远高于银行（尽管波动性更大）。波士顿咨询集团估计，2020年另类资产管理公司赚取了全球资产管理收入的超过40%。

自1980年代起飞以来，私募行业已经经历了两个“繁荣-萧条”周期。第一次繁荣是由善于营造声势的交易商推动的，以KKR的联合创始人亨利·克拉维斯（Henry Kravis）和乔治·罗伯茨（George Roberts）为代表。它的标志性交易是1988年以250亿美元高杠杆收购雷诺兹·纳贝斯克（RJR Nabisco）。第一次萧条很快到来。在始于1990年代后期的第二次繁荣中，行业规模升级，扩展到了股权和美国以外。由黑石带头，几家资产管理公司利用这轮繁荣来上市自己的股票，靠费用收入赚取现金，并给GP们提供更多退出机制。自那以后已有更多公司效法。旧金山的杠杆收购公司TPG的资产约1100亿美元，于今年1月在纳斯达克上市。

| 强势回归

金融危机打击了私募市场，但随着利率下降，廉价的债务推动了它的反弹。即使是2020年新冠肺炎的到来也没有给它长期打击。交易活动暂时陷入冰封，但私募公司开始为自己投资组合中需要帮助的公司提供支撑，有时也是为了趁机买入廉价资产。当年晚些时候，并购活动已再度活跃起来。

私人市场受到推、拉两种力量驱动，穆罕默德·埃尔埃里安（Mohamed El-Erian）表示。他是保险公司安联（Allianz）的首席经济顾问，曾任债券基金投资管理公司PIMCO的老板。主要的推力是超宽松货币政策，它把投资者推向提供更高收益的非流动性市场。另一股推力是更严格的资本要求和危机后立法（例如美国的多德-弗兰克法案）导致银行后撤，这些法律不鼓励或禁止它们用自己的资产负债表押注。私募基金欣然补上了银行腾出来的空位。拉力则包括私人债务和房地产投资基金等的创新，旨在吸引富有的个人和机构。

随着私人市场发展扩大，越来越多年轻公司选择了推迟上市。在上世纪八九十年代的美国，进行IPO的公司平均已创立八年；自2001年以来上升到

11年。“私募股权已经重新定义了自己的角色：前往公开市场的中继站。”专注于成长型投资的私募公司华平投资（Warburg Pincus）的老板纪杰（Chip Kaye）说。

随着企业保持私有的时间延长，“越来越多的投资者正寻求在这个‘前IPO’阶段进场，因为大部分的财富创造都发生在这个时期。”基金集团富兰克林邓普顿（Franklin Templeton）的孟宇（Ben Meng）表示。一些公司选择永远不上市，因为它们有信心在私人市场筹集到足够的资金，为家族企业服务的商业银行BDT Capital Partners的主管拜伦·特罗特（Byron Trott）表示。BDT自2009年以来投资了40家公司，迄今只有3家已上市。

这并不是说公开市场已经偃旗息鼓。去年是IPO上市创纪录的一年。企业要上市还有其他途径，比如直接上市或与特殊目的收购公司（SPAC）合并，后者在2020到2021年间大热后遇冷，不过不太可能完全消失。但是，美国上市公司目前总数约4000家，远低于1990年代中期近6000家的峰值。原因之一是投资者看到了上市的劣势，包括繁重的披露要求、季度收益压力，以及成为维权投资者的靶子。

在私募持有的公司中，维权分子来自内部。所有者与管理者紧密合作，制定出战略和资本结构。它们慷慨奖励成功，而惩罚失败的速度也比上市公司的股东更快。如果做对了，这可以缩小股东和管理层之间的信息差，从而增加价值，降低代理成本。为私人市场提供弹药的捐赠基金、养老基金和其他机构投资者都是信徒。它们认为，大量配置另类投资最有望实现自己投资组合的年度回报目标，这些目标通常都在7%到9%左右。

但随着该行业进入自己的第三个时代，它面临挑战。一是通胀和利率持续走高的前景。廉价债务是私募的命脉。借贷成本上升两三个百分点不大可能导致破产激增。再多一点就不好说了。贝恩咨询的麦克阿瑟说，随着更多资本流入了私人市场，资产价格已经涨到“没什么犯错的余地”。就收购来说，平均报价与盈利之比目前处于历史最高水平。

第二个担忧是更严格的审查。私人市场监管宽松且不透明。监管机构希望

提高透明度，尤其是在费用和业绩指标方面。官员们想知道私人市场会如何影响金融稳定性。该行业也必须在地缘政治中摸索，尤其是中国在重新评估外资的好处，而直到最近中国一直都是许多资产管理者的投资计划中的很大一块。去年9月，黑石以30亿美元收购房地产开发商SOHO中国的交易流产，就是一个不祥之兆。

最后的考验来自内部：代际变化。许多塑造了该行业的人正在离开。克拉维斯和罗伯茨去年把公司移交给了新的联席主管。黑石75岁的联合创始人苏世民（Stephen Schwarzman）仍是老板，但更多日常职责已落在52岁的总裁乔纳森·格雷（Jonathan Gray）身上。阿波罗的联合创始人莱昂·布莱克（Leon Black）在被调查与杰弗里·爱泼斯坦（Jeffrey Epstein）的关系后于去年3月辞职。在凯雷，一位联席CEO在权力斗争中败下阵来后于2020年辞职。新领导者能否让魔法继续？挑战变得更严峻了，这是因为——用投资公司Partners Capital的斯坦·米兰达（Stan Miranda）的话说——“我们经历了环境日趋友好的黄金四十年。这真是不可思议——它也很可能已经到头了。”

本专题审视当过去十年的利好消逝后所面临的风险，以及私人市场赢得新投资者之时的机遇。它展望一个单靠拿下收购大案已不再足够的未来。它探讨机构投资者的需求以及新兴的私人债务市场，也探查潜在的监管和声誉地雷。本报道聚焦美国。私人市场已经变得更加全球化，但一个不变的事实是纽约的今天是伦敦或上海的明天。■



Strategic priorities

Alternative fund managers are increasingly mainstream

But many “artisanal” PE firms are touting themselves as specialists

BLACKSTONE STARTED life in 1985 with \$400,000 in seed capital and plans as an advisory boutique. Its founders, Peter Peterson and Stephen Schwarzman, wanted to try leveraged buy-outs too, but struggled to get backing. That was then. In October Mr Schwarzman called his New York-based firm the private markets’ “reference institution...reinventing the asset class”. It is a justifiable boast. Blackstone towers above rivals, with \$880bn of managed assets. “Ten years ago we were essentially a small club with a select group of investors focused on private equity, with a bit of real estate and distressed debt,” says Mr Gray at Blackstone. “Now we have a much wider group of investors saying ‘If you can get us a competitive return across private equity, lending, real estate, infrastructure or one of a number of other strategies, we’re happy to have the capital tied up.’”

PE firms are often said to be the “new conglomerates”, given increasingly diverse portfolios. Unlike their industrial predecessors, they show capital discipline; owned companies are not cross-subsidised willy-nilly. The dozen or so firms atop the industry are more than corporate conglomerates. The likes of Blackstone and KKR “don’t much like the term, but they’re starting to look more like financial supermarkets,” says Tim Jenkinson of Oxford University’s Saïd Business School. One sign of this is a proliferation of distinct private-market strategies (eg, mid-cap industrials or commercial property).

Listing on public markets was a formative moment for alternative managers. The two main sources of PE income are management and performance fees; the second is known as carried interest (or carry). In the early days, carried interest was PE’s main source of profit, with

management fees designed only to cover administrative costs. But the latter are more important now, making up 60-70% of GPs' total profits, says one study.

Public markets find management fees easier to value than performance fees, which are more erratic. Floating a firm's shares was an obvious way to monetise the fees' future flows (as well as making it much easier for partners to cash out). The industry's latest IPO, by TPG in January, was structured to give public investors what they most wanted, the management fees, while keeping most of the carried interest for owner-managers.

Once a firm goes public, the incentive is to maximise management fees. The best way to boost a share price is to gather assets furiously, not spend time painstakingly choosing the right buy-out targets. And because alternative managers can charge higher fees than those in the public markets, they enjoy higher valuation multiples. Blackstone has an eleventh of the assets of BlackRock, the world's largest fund manager, but a higher market capitalisation.

Blackstone aims to reach \$1trn of assets within a few years, as does another giant, Apollo. The race to bulk up will accelerate a bifurcation of the industry, says Mr Jenkinson. As giants go for scale and breadth, a long tail of "artisanal" PE firms will tout themselves as specialists who make superior returns by focusing on particular areas or geographies, doing just a few deals a year.

Gone are the days when the big PE firms focused on value, not growth. Today's targets are often not the metal-bashers of old, but zippy new-economy firms. Software, health tech and green tech are hot. Last year one in three PE deals was classed as tech, twice the share before 2007-09. Blackstone hopes to become a king of content as well: its burgeoning media

portfolio includes Moonbug and Hello Sunshine, which make TV shows for kids and women.

The search has led the industry into growth equity, a once-tiny sliver between venture capital (VC) for startups and buy-outs for mature firms. Growth equity makes up around 20% of all PE, about the same as VC, with buy-outs accounting for the rest, says Stan Miranda of Partners Capital. Growth equity is useful for firms entering adulthood but unsure about going public.

The focus on fast-growing firms has pushed up valuations. The average price for American leveraged buy-outs has climbed to 11.4 times earnings before interest, tax, depreciation and amortisation (EBITDA); even in heady pre-crisis years it did not exceed nine. Scott Kleinman, co-president of Apollo, one of the few big PE firms not to buy heavily at such multiples, suggested that the industry was gripped by a “collective delusion” on valuations.

Leverage is jangling nerves, too. It has fallen as a percentage of total capital in buy-outs: from 90% in the 1980s to around 70% before the crisis, and less than 50% today. Measured against earnings, however, it is at its highest relative to EBITDA for two decades. Over four-fifths of the American buy-out market is leveraged more than six times earnings, the level at which “Federal regulators start to raise eyebrows,” says Bain & Company.

Dealmakers say prices look high only because acquisitions offer fast-growing, not just dependable, earnings. They say they have largely given up financial engineering, when the game was to buy unexciting firms with steady cashflows, leverage up and squeeze out juicy returns before selling them on, and embraced an operational version. The aim is to buy and improve good companies. PE firms have hired specialist fixer-uppers. KKR says it has three “supporting colleagues”, steeped in marketing strategy,

employee engagement, regulatory risk and much else, for every portfolio manager in North America. “The buy, fire and sell image of the industry is so far from what we do,” says Mr Gray.

So too, he says, is PE’s reputation for indifference to environmental concerns. The big firms talk up “green tech” and the energy transition. Some put money where their mouths are: Toronto-based Brookfield Asset Management has raised a \$15bn “Transition Fund”. In September a group of investors and PE firms, including Blackstone and Carlyle, launched an initiative to standardise environmental, social and governance (ESG) reporting in buy-outs. Some embrace other forms of stakeholderism: KKR is championing employee ownership. At Ingersoll Rand, a machinery firm, 16,000 workers have been given equity. KKR claims this has helped produce a meaningful improvement in company performance, including an 80% decline in the voluntary quit rate.

| *Going green, too*

Investors, known as limited partners (LPs), want more of this. In a recent survey by Collier Capital, 56% of European LPs said ESG had played a role in rejecting fund commitments over the previous year. (America is behind, at 25%.) Several investors express optimism that PE firms can take a lead on greening business. “If they see it as good for the bottom line long-term, they can move quickly because of the power they have over their portfolio companies,” says Tilly Franklin, Cambridge University’s chief investment officer. Yet plenty of PE firms remain interested in “brown” assets at the right price. Some are buying oil companies and sniffing around coalmines that publicly listed operators want to divest.

As the industry embraces change, it is also looking for new types of investors. Mr Gray talks of “a revolution not just in what we do but who we do it for”. Large institutions will be its biggest clients for many years to come, but private funds are keenly searching out retail investors as well.

That would deepen the pool of capital that could be tapped by a cool \$50trn, reckons Bain. “Retail has been the holy grail of private markets since Steve Schwarzman got out of the advisory business a generation ago,” says one industry veteran.

The PE giants are hustling for high-end retail business from clients who count as “accredited” investors whom regulators deem sophisticated enough to buy private assets. The big firms are also strengthening private-wealth teams, in some cases poaching from banks. Alisa Wood of KKR says the firm is looking to raise a third or more of its capital from retail investors. Apollo expects individuals and advisers to invest \$50bn over the next five years. To that end, in December Apollo acquired part of Griffin Capital, a Los Angeles-based fund manager. The next target is the “mass affluent”, or merely quite well off, who have little invested in private markets and want more. Several firms, including Blackstone and Brookfield, have launched or are working on PE, credit, property or infrastructure funds tailored to smaller investors.

One difficulty over turning this retail trickle into a flood is illiquidity. Retail investors want to trade in and out of investments at a reliable net asset value, if not daily then weekly or monthly. That is not easy to engineer with private assets. Some at the cutting edge are making headway. Swiss-headquartered Partners Group manages over \$36bn in open-ended PE funds for investors including wealthy retail clients. Investors receive monthly net asset values and can redeem at 30-90 days’ notice (though funds can halt redemptions during market turmoil). Another barrier is regulation. Rule-setters have long been queasy about throwing private markets open to mom-and-pop investors.

There are signs that regulatory resistance is softening. Last year a panel convened by America’s Securities and Exchange Commission (SEC) backed giving retail investors greater access to private markets as long as there

were investor protections. America's Department of Labour also opened the door for defined-contribution (DC) pension plans to invest (defined-benefit plans have long done so). In November the British government proposed raising the ceiling on the fees that DC plans can pay. If enacted, this would allow them to invest in unlisted assets.

The retail push aims both to increase clients and to grow fee-based revenues. This goes hand in hand with the objective of raising more "perpetual" capital. Not only are profits from traditional PE funds erratic, but also the funds have to be wound up, typically after ten years. Big firms want to move away from this here-today-sold-tomorrow model. They like vehicles that can invest for longer, or are open-ended, avoiding the need to go cap in hand to investors every few years. Mr Gray has said that long-term capital "allows us to broaden who we serve and where we can invest. We've compared this to a ship moving from a narrow channel into open waters, and we believe this process has just begun."

Similar thinking underlies efforts to tap long-term insurance pools of capital, according to Dec Mullarkey of SLC Management. Big firms have stepped up their purchases of books of annuities or life insurance on which insurers are struggling to make a return because of low interest rates. The typical PE investor acquires such books for their fee income, then brings down costs and spruces up their asset mix. Some of this is done using private-credit markets, where spreads are higher than in public markets. "We only need to earn 50 basis points [half a per cent] over what the annuity pays out to do nicely," says one investor.

Apollo has pushed furthest into insurance. It set up Athene Holding in 2009 to buy annuity blocks, later floating its shares. It has since acquired stakes in other insurers. Today, Athene makes up around 40% of Apollo's total assets. KKR is doing something similar. Blackstone is taking minority investments in insurers in exchange for exclusive asset-management

arrangements. Last summer it bought 10% of AIG's Life and Retirement business for \$2.2bn. In return, Blackstone gets a long-term agreement to manage \$50bn of AIG assets.

| *Public players' private passion*

As alternative asset managers grow less alternative, mainstream managers are getting more so. Nudged by clients in search of yield, they are looking to cash in on private-market strategies. They would also welcome the chance to charge higher fees, having seen those from conventional stock funds shrivel with the rise of passive investing.

Private markets were the busiest area of dealmaking for big mutual-fund firms in 2021. Franklin Templeton paid \$1.8bn for Lexington Partners, which has raised more than \$55bn for alternative strategies. It also hired Ben Meng, a former investment officer of a Chinese state agency which manages \$3trn, to lead a push into Asia. T. Rowe Price splashed out \$4.2bn for Oak Hill Advisors, a private-credit specialist. "They bring products our clients want, and we bring distribution," says Rob Sharps, T. Rowe Price's boss. Vanguard is expanding, through a partnership with HarbourVest Partners, a big PE fund of funds. Critics suggest that venturing into an area known for high fees and opacity would send Jack Bogle, Vanguard's founder, spinning in his grave, but the firm argues that the move helps to give the little guys access to markets previously monopolised by institutions.

BlackRock, the world's largest asset manager, has been quietly building an alternatives business. It has amassed assets of \$320bn, more than all but the three largest alternative managers. Half its business is private credit, much of the rest property and infrastructure. The firm also has a growth-equity partnership with Temasek, a Singaporean sovereign-wealth fund. As BlackRock moves onto the same turf as its original parent, Blackstone, there may in 20 years' time be little to differentiate the two except for the

second syllable of their names. ■



战略重点

另类基金经理日趋主流

但许多“精品”私募股权公司吹嘘自己是专家【专题《私人市场》系列之二】

黑石于1985年以40万美元的种子资本创立，并计划成为一家精品咨询公司。它的创始人彼得·彼得森（Peter Peterson）和苏世民（Stephen Schwarzman）也想尝试杠杆收购，但难以获得支持。今非昔比。10月，苏世民把他总部位于纽约的公司称为私人市场的“参考机构.....正在重塑这一资产类别”。这自夸所言非虚。黑石以8800亿美元的管理资产远超竞争对手。“十年前，我们基本上是一个小俱乐部，拥有一小群专注于私募股权的投资者，还有一点房地产和不良债务，”黑石的格雷说，“现在有一个广泛得多的投资者群体，它们说，‘如果你能让我们在私募股权、贷款、房地产、基础设施或其他一些策略中获得有竞争力的回报，我们很乐意把资金拴在这里。’”

鉴于其投资组合日益多样化，私募股权公司常常被称为“新企业集团”。与工业界的前辈不同，它们表现出了资本纪律，持股的公司不会随意交叉补贴。该行业头部的十几家公司不仅仅是企业集团。牛津大学赛义德商学院的蒂姆·詹金森（Tim Jenkinson）说，黑石和KKR之类的公司“不大喜欢这个词，但它们开始看起来更像金融超市了”。这方面的一个迹象是独特的私人市场战略（例如，中盘工业类股或商业地产）的涌现。

在公开市场上市是另类资产管理公司的里程碑时刻。私募股权收入的两个主要来源是管理费和绩效费；第二种称为附带权益（或超额收益）。早期，附带权益是私募股权的主要利润来源，管理费仅用于支付管理成本。但一项研究表明，后者现在更为重要，占普通合伙人总利润的60%到70%。

公共市场发现管理费比绩效费更容易估值，后者更加不稳定。让公司股票流通是一种将未来的费用流货币化的显而易见的方式（同时也让合伙人变现的便利度大增）。该行业最近的一次IPO是1月份TPG上市，旨在为公众

投资者提供他们最想要的东西——管理费，同时将大部分附带权益留给业主经理。

一旦公司上市，激励就是最大化管理费用。提高股价的最好方法是疯狂地收集资产，而不是花时间苦心选择正确的收购目标。而且由于另类资产管理公司可以收取比公开市场更高的费用，它们享有更高的估值倍数。黑石拥有的资产是全球最大的基金管理公司贝莱德的十一分之一，但市值更高。

黑石的目标是在几年内达到1万亿美元的资产，另一家巨头阿波罗也是如此。詹金森说，扩大规模的竞赛将加速行业的分化。随着巨头们追求规模和广度，“精品”私募股权公司的长尾将吹嘘自己是专家，通过专注于特定领域或地区，每年只进行几笔交易而获得更高的回报。

大型私募股权公司专注于价值而非增长的日子已经一去不复返了。今天的目标往往不是过去冲压金属的厂商，而是敏捷的新经济公司。软件、健康和绿色科技很热门。去年，三分之一的私募股权交易被归类为科技股，是2007到2009年金融危机前比例的两倍。黑石也希望成为内容之王：其新兴的媒体组合包括为儿童和女性制作电视节目的Moonbug和Hello Sunshine。

这种目标搜寻引导该行业进入成长型股权，这是介于对创业公司的风险投资（VC）和对成熟公司的收购之间曾经微小的一块。合伙人资本

（Partners Capital）的斯坦·米兰达（Stan Miranda）表示，成长型股权约占所有私募的20%，与VC大致相同，其余部分是收购。成长型股权对于进入成年期但不确定是否要上市的公司很有用。

对快速增长的公司的关注推高了估值。美国杠杆收购的平均价格已攀升至息税折旧摊销前利润（EBITDA）的11.4倍，而即使在危机前狂热的那几年里这个倍数也不曾超过9。阿波罗是少数几个不会以如此高的倍数大量买入的大型私募股权公司之一，其联合总裁斯科特·克莱恩曼（Scott Kleinman）表示，该行业陷入了对估值的“集体错觉”。

杠杆也让人神经紧张。它在收购中占总资本的百分比已经下降：从1980年代的90%下降到危机前的70%左右，而今天还不到50%。然而，如果用收益衡量，它相对于EBITDA的倍数是二十年来的最高值。贝恩咨询表示，超过五分之四的美国收购市场的杠杆率超过了市盈率的六倍，“联邦监管机构开始注意到这一点”。

交易者表示，价格看起来高只是因为收购提供了快速增长的收益，而不仅仅是可靠的收益。他们表示已基本上已经放弃了过去那种金融工程——收购拥有稳定现金流的平淡无奇的公司，提高杠杆并挤出丰厚的回报，然后再卖给别人。现在他们拥抱了一种运营工程。目标是收购和改进优秀的公司。私募股权公司聘请了“翻修”专家。KKR表示，它为北美的每位投资组合经理提供了三位“支持同事”，专注于营销策略、员工敬业度、监管风险等许多方面。“这个行业在人们心中那种买入、解雇再卖出的形象和我们现在实际所做的相差甚远。”格雷说。

他说，私募对环境问题漠不关心的名声也是如此。大型私募公司大谈“绿色技术”和能源转型。有些人言行一致：总部位于多伦多的博枫资产管理公司（Brookfield Asset Management）筹集了150亿美元的“过渡基金”。9月，包括黑石和凯雷（Carlyle）在内的一组投资者和私募股权公司发起了一项举措，旨在规范收购中的环境、社会和治理（ESG）报告。有些人接受其他形式的利益相关者主义：KKR倡导员工持股。在机械公司英格索兰，16000名工人获得了股权。KKR声称这帮助显著改善了公司业绩，包括自愿离职率下降了80%。

| 也要变绿色

被称为有限合伙人（LP）的投资者想要更多这样的东西。在科勒资本

（Coller Capital）最近的一项调查中，56%的欧洲的LP表示ESG在去年拒绝为基金承诺出资方面发挥了作用。（美国落后，为25%。）一些投资者对私募股权公司可以在绿色业务方面发挥带头作用表示乐观。剑桥大学首席投资官蒂莉·富兰克林（Tilly Franklin）表示：“如果它们认为这有利于长期盈利，就可以迅速采取行动，因为它们对投资组合公司拥有强大的影响力。”不过，许多私募股权公司仍然对价格合适的“棕色”资产感兴趣。一

些正在收购石油公司，并四处寻找上市运营商想要剥离的煤矿。

随着行业拥抱变革，它也在寻找新类型的投资者。格雷谈到“一场不仅改变我们做什么，还有为谁做的革命”。大型机构投资者将是该行业未来许多年里最大的客户，但私人基金也在热切地寻找散户投资者。贝恩认为，这将让可用的资金池加深50万亿美元。“自一代人以前苏世民退出咨询业务以来，零售一直是私人市场的梦想。”一位行业资深人士说。

私募股权巨头正在从被划为“合格”投资者的客户那里争夺高端零售业务，监管机构认为这些投资者已足够成熟而可以购买私人资产。大公司也在加强私人财富团队，在某些情况下是从银行挖人。KKR的艾莉莎·伍德（Alisa Wood）表示，公司正在寻求从散户投资者那里筹集三分之一或更多的资金。阿波罗预计个人和顾问将在未来五年内投资500亿美元。为此，阿波罗在12月收购了总部位于洛杉矶的基金管理公司格里芬资本（Griffin Capital）的部分股份。下一个目标是“富裕大众”，也就是还算富裕的人，他们对私人市场的投资还很少，并且想要投入更多。包括黑石和博枫在内的几家公司已经推出或正在开发专为小型投资者量身定制的私募股权、信贷、房地产或基础设施基金。

将这种零售涓涓细流变成洪水的一个困难是流动性不足。散户投资者希望以可靠的资产净值买卖投资，如果不是每天交易，也要每周或每月交易。私人资产要做这种设计并不容易。一些处于最前沿的公司正在取得进展。总部位于瑞士的合众集团（Partners Group）为包括富有的零售客户在内的投资者管理超过360亿美元的开放式私募股权基金。投资者每月收到资产净值，可以提前30到90天通知赎回（不过基金可以在市场动荡期间暂停赎回）。另一个障碍是监管。长期以来，规则制定者一直对向家庭投资者开放私人市场感到不安。

有迹象表明监管阻力正在减弱。去年，美国证券交易委员会（SEC）召集的一个专家组支持让散户投资者更多地进入私人市场，只要有投资者保护措施即可。美国劳工部也为固定缴款（DC）养老金计划的投资打开了大门（固定收益计划早就在这样做了）。11月，英国政府提议提高DC计划

可以支付的费用上限。如果得到立法，这将允许它们投资非上市资产。

推动零售旨在增加客户和费用收入。这与筹集更多“永久”资本的目标齐头并进。传统私募股权基金不仅利润不稳定，而且通常必须在十年后清盘。大型私募公司希望摆脱这种“今天存在明天卖出”的模式。它们喜欢可以投资更长时间或没有终点的工具，从而避免每隔几年就得对投资者卑躬屈膝。格雷曾表示，长期资本“使我们能够扩大服务对象以及可以投资的领域。我们将此比作一艘船从狭窄航道驶入开阔水域，并相信这个过程才刚刚开始。”

SLC管理公司（SLC Management）的德克·穆拉基（Dec Mullarkey）表示，类似的想法是开发长期保险资金池的基础。大公司已经加大了购买年金或人寿保险的力度，而由于低利率，保险公司难以从这些项目上获得回报。典型的私募投资者购买此类资产是为了获得费用收入，然后降低成本并完善其资产组合。其中一些是通过私人信贷市场完成的，其中利差高于公共市场。一位投资者说：“我们只需要比年金支付的费用多赚50个基点[0.5%]就可以过得很好。”

阿波罗在保险业方面走得最远。它于2009年成立了雅典娜控股（Athene Holding）以购买年金组合，随后将其股票上市。此后，它收购了其他保险公司的股份。今天，雅典娜约占阿波罗总资产的40%。KKR也在做类似的事情。黑石正在对保险公司进行少数股权投资，以换取独家资产管理安排。去年夏天，它以22亿美元收购了美国国际集团（AIG）的人寿和退休业务10%的股份。作为回报，黑石获得了管理500亿美元AIG资产的长期协议。

| 公开玩家的私密热情

随着另类资产管理公司变得不那么另类，主流资产管理公司却越来越另类了。在客户寻求收益的推动下，它们正在试图从私人市场策略中获利。它们也欢迎能收取更高费用的机会，因为传统股票基金的费用已随着被动投资的兴起而萎缩。

私人市场是2021年大型共同基金公司最繁忙的交易领域。富兰克林邓普顿（Franklin Templeton）斥资18亿美元收购了列克星敦投资（Lexington Partners），后者为另类策略筹集了超过550亿美元。它还聘请了管理着3万亿资产的中国国有机构的前投资官孟宇领导进军亚洲。普徠仕（T. Rowe Price）斥资42亿美元收购私人信贷专家橡树山顾问公司（Oak Hill Advisors）。“它们带来我们客户想要的产品，而我们带来分销。”普徠仕的老板罗布·夏普斯（Rob Sharps）说。先锋领航（Vanguard）正在通过与大型私募母基金公司汉柏巍投资（HarbourVest Partners）的合作进行扩张。批评者认为，冒险进入一个以高费用和不透明著称的领域要让先锋领航的创始人杰克·博格尔（Jack Bogle）的棺材板都压不住了，但该公司说，此举有助于让普通人进入以前由机构垄断的市场。

全球最大的资产管理公司贝莱德一直在悄悄建立另类业务。它已经积累了3200亿美元的资产，超过了除三大另类管理公司之外的所有公司。其中一半业务是私人信贷，其余大部分是房地产和基础设施。该公司还与新加坡主权财富基金淡马锡建立了成长型股权合作伙伴关系。随着贝莱德与当初的母公司黑石进入同一块地盘，再过20年，除了名字的第二个音节之外，两家公司可能就没什么区别了。■



The investors

Investors rely more and more on higher returns from private markets

The institutional investors whose capital fuels private markets are growing more sophisticated. But picking winners gets no easier

WHEN DAVID SWENSEN died last year, the investing world mourned the loss of an icon. As head of Yale University's nest-egg, Swensen pioneered the endowment model: eschewing bonds and lowering holdings of equities in favour of PE and property. His philosophy was that long-term capital could give up some liquidity for higher returns; and, with data scarcer in private markets, that it was easier for those who did their homework to gain an edge. In his 36 years at the helm, the endowment grew from \$1.3bn to over \$40bn, an average 13.7% compound annual gain.

The revolution Swensen started has spread to other endowments and foundations, and then to sovereign-wealth and pension funds and money managers for the super-rich. Academic institutions remain the trailblazers. In the 2020 fiscal year, leveraged buy-outs, VC and real assets made up an average 39% of the portfolios of American university endowments with more than \$1bn. Yale has 45% in buy-outs and VC alone. But institutional investors of all stripes have been gradually raising their allocations to private markets, typically to percentages in the high teens or low 20s. Many plan to go higher: in a survey last year by Preqin, a research firm, around 90% said they expected to commit the same or more to PE funds over the next 12 months.

Last November CalPERS, America's largest public-pension fund with around \$500bn under management, signalled plans to increase PE and private debt from 8% to 18% of its portfolio. This is meant to keep CalPERS' expected returns above its long-term target of 6.8%; falling short would matter to a fund whose obligations to pensioners already exceed the

current value of its assets by over \$160bn. “Most LPs just wish their boards would give them more access to private markets,” says a consultant to big investors.

Their investments are mostly made through GP-sponsored funds with a set lifespan. A growing share of funds buy investors’ existing commitments in the “secondary” market for PE stakes. This has boomed recently: 2021 saw a record \$126bn in transactions, 50% higher than in 2019, the previous peak. Big private-markets firms like Ares and KKR are acquiring secondary specialists or looking for targets. LPs used to sell stakes into the secondary market only in a cash crunch. Now they do so freely, as a tool of active management, eg to increase exposure to a sector or reduce it to a region. GPs have become big secondary players, too. One popular innovation is a “continuation fund”, essentially a vehicle for a GP to sell stakes to itself. One aim is to delay selling prized assets that might have to be divested as an old fund winds down.

The 50 or so largest LPs have used their clout to invest differently. Some make half their private-markets commitments outside fund structures, either “directly” or as “co-investors”, alongside a fund (in which they may also have a stake). The busiest direct and co-investors are Asian sovereign-wealth funds, such as Singapore’s GIC and Temasek, and Canada’s pension giants, including CPP Investments and the Ontario Teachers’ Pension Plan (OTPP).

The OTPP acquired 85% of the private assets in its \$220bn portfolio as a direct investor. It ranges from lottery operators to renewable-energy facilities. To beef up its capability it has built an in-house investment team, now 350 strong. “We like influence, and we think in a 30-year horizon. That’s too long for most private-equity funds,” says Jo Taylor, the OTPP’s chief executive. Andrea Auerbach of Cambridge Associates, an investment firm, reckons co-investment alone now accounts for a quarter of big

investors' commitments, up from 10% 15 years ago.

As well as giving investors more control, direct and co-investment can boost returns. Over the past 25 years the OTPP's direct investments have delivered a top-quartile return of around 20%, above that of its investments through funds. Between 2009 and 2016, around 80% of all co-investments outperformed funds launched in those years, says Michael Cembalest of JPMorgan Chase.

Higher returns are no mystery. Direct and co-investors avoid fees paid by fund investors: typically a 1.5-2% management fee and 20% performance fee (the manager's "carried interest"). Institutions that do a lot of freelance investing can bring "blended" management fees down to 1-1.5%. The Universities Superannuation Scheme, an £82bn (\$110bn) pension scheme in Britain, has saved its members "hundreds of millions" by investing directly, says Geoffrey Geiger, its head of PE funds. The extra staff cost pales beside the fees saved, says Matt Portner of McKinsey.

| *A good deal?*

GPs are ambivalent about this. It means forgone fees, but it can still be useful. Some funds would find it hard to make large investments without co-investors, because of risk limits on single holdings as a share of the total. Blackstone and its partners would have struggled to complete the \$34bn purchase last June of Medline, a medical-supply giant, without co-investors, including GIC.

Most investors pay close to the infamous "2 and 20". Gary Gensler, chair of the SEC, said last year that average PE management and performance fees in 2018-19 were 1.76% and 20.3%, respectively, "not that different from when I was on Wall Street" in the 1980s. Other expenses can push overall fees, including carried interest, up to 5% or more per year over the life of a fund. These include charges for "monitoring" portfolio companies, for

administrative expenses, or even for use of private jets. StepStone, a private-markets advisory firm, memorably described PE fees as “like snowflakes: abundant, unique and lacking in transparency”.

LPs don't kick up much fuss about fees partly because they fear being excluded from GPs' future funds or co-investment opportunities. Some keep quiet because they get rebates under side agreements. Still, many complain that fees are too high and that the fee structure is rigid even though funds' performance varies. Others grumble that fees are charged on all committed capital, not just that actually deployed.

Some GPs seek to assuage such concerns. A few have switched to charging based on funds deployed. One large investor predicts that PE will eventually follow hedge funds: when relative returns sagged after the financial crisis, some hedge funds closed, others turned into family offices, and many of the rest cut fees.

Yet 2 and 20 is likely to stay as PE's reference point. “The way the buy-out and venture-capital markets are rationed is that managers of underperforming funds struggle to raise more money and fade away rather than staying in business by slashing fees,” says Steven Kaplan of Chicago University's Booth business school. The head of one American endowment's PE portfolio says that, if anything, there is greater pressure on LPs to pay more than 20% carried interest for good results than to pay less than 20% for below-average results. Some investors will pay 25% or more if the manager delivers something special, such as four times the original investment.

The biggest factor limiting pressure from LPs for lower fees is their faith that unlisted investments will continue to outperform public markets. PE firms tout dizzying returns over the past 20 years. Academics who crunch the data are split, though not down the middle. A small, vocal minority, led

by Ludovic Phalippou of Oxford's Saïd Business School, argues that PE's outperformance is an illusion created by an industry that has mastered ways to massage the numbers. Over the past decade, Mr Phalippou calculates, returns have merely matched those of stockmarkets. For GPs to insist otherwise amounts to "a mis-selling scandal".

Most other boffins disagree. They acknowledge that the "internal rate of return" (IRR) measure favoured by the industry is flawed: it can be gamed by playing around with cashflows or by taking out "subscription lines", loans that managers get from banks to delay calling capital from LPs. However, the academics have developed their own, more solid metrics. The best of these is "direct alpha", a less manipulable, market-adjusted version of IRR.

A paper in January from the Institute for Private Capital at the UNC Kenan-Flagler Business School calculated direct alpha since the mid-1990s for funds in the 1986-2016 vintages. It found that PE, including buy-outs and VC, outperformed shares over all time periods (three, five, ten, 15 and 25 years) by 2-6 percentage points. It beat them regardless of the benchmark used; the authors tested among others the MSCI's global-equities index, the Russell 3000 index of US stocks and a small-cap value index.

The less good news is that the performance gap has narrowed. As private markets get more crowded, competition for stand-out investments intensifies. And as the industry gets bigger, it learns the truth of Warren Buffett's dictum that "no one in the world can earn 20% with big money." The real question, says Gregory Brown, the study's lead author, is whether private assets are worth it once returns are adjusted for risk. PE's "beta" (risk relative to markets) is 20-30% higher than that of equities. Investors also demand a premium for illiquidity (the consensus is around three percentage points a year, says the BIS). Against this, investors must weigh the diversification benefits of holding private assets.

Even if institutional investors conclude that PE pays, average returns are just an average. Pick a below-average fund and you can be soaked in red ink. The gap in performance between top- and bottom-quartile PE funds is wider than in public markets: for some vintages 15 points or more. One-fifth of PE investments return less than was put in, reckons one private-markets adviser.

Picking winners is made harder by a weakening of the link between past and future performance. The odds that a PE manager's next fund will be in the top quartile if its previous one was have fallen over time, to "not much better than 25%", as the industry has grown, says Mr Jenkinson. And information about past performance is often incomplete: investors must decide whether to back a manager's next fund three or four years after the previous one started investing, long before its final returns are clear. Even in the highest reaches of private markets, investing is as much about keeping the faith as studying the form. ■



投资者

投资者日益依赖私人市场的更高回报

为私人市场提供燃料的机构投资者越来越老练。但挑选赢家并没有变得更容易【专题《私人市场》系列之三】

去年戴维·斯文森（David Swensen）去世时，投资界为失去一位偶像而哀悼。这位耶鲁大学的储备金管家开创了“捐赠基金模式”：避开债券并减持股票，增配私募股权和房地产。他的理念是，长期资本可以放弃一些流动性以换取更高回报，而且鉴于私人市场的数据更稀缺，好好做功课的人更易取得优势。在他掌舵的36年里，该捐赠基金从13亿美元增长到超过400亿，年均复合增长率为13.7%。

斯文森发起的这场革命已经传播到其他捐赠基金和基金会，后来又蔓延到主权财富基金、养老基金，以及为超级巨富理财的公司。学术机构仍然冲在最前面。2020财年，在美国十亿美元以上大学捐赠基金的投资组合中，杠杆收购、风险投资和实物资产平均占到了39%。在耶鲁的投资组合中，仅收购和风投就占到45%。但各种各样的机构投资者都已在逐步提高它们对私人市场的配置，通常占比在15%到25%之间。许多计划进一步提高占比。在研究公司Preqin去年的一项调查中，约九成机构投资者表示，预计未来12个月内会将同样多或更多的资金投入到了私募基金。

加州公共雇员养老基金（CalPERS）是美国最大的公共养老金基金，管理着约五千亿美元，去年11月表示计划将私募股权和私人债务从其投资组合的8%增加到18%。这是为了让该基金的预期回报率能保持在6.8%的长期目标之上。达不到目标会很麻烦，因为该基金对养老金领取者的支付义务已经超出其资产当前价值1600多亿美元了。“大多数LP都很希望自己的董事会能让它们更多地参与私人市场。”一位机构投资顾问说。

它们的投资主要是通过GP发起的固定期限的基金展开的。越来越多基金在“二级”私募股权市场购入投资者既有的承诺出资。这类活动近来蓬勃发展，在2021年的交易额达到创纪录的1260亿美元，比上次高峰出现的2019

年高出50%。阿瑞斯（Ares）和KKR等大型私人市场公司正在招募二级市场专家或寻找购入目标。过去，LP只会在现金紧缺的情况下把股份放到二级市场出售。现在它们随心所欲地这样操作，把它用作一种主动式管理工具，例如扩大对某个行业的风险敞口，或把敞口缩减至某个区域。GP也已成为二级市场的一大参与者。一项流行的创新是“延续基金”，本质上就是一种让GP能把股份卖给自己的工具。目的之一是延迟出售可能因旧基金关闭而不得不剥离的高价值资产。

大约50家最大的LP利用自身影响力以不同方式投资。有些将对私人市场承诺出资的一半都放在基金结构以外，或“直接”投资，或充当“联合投资方”，即与一只基金（它们也可能持有股权）联合投资。最活跃的直接和联合投资者是亚洲主权财富基金，比如新加坡政府投资公司（GIC）和淡马锡控股（Temasek），以及加拿大的养老金巨头，包括加拿大养老金计划投资公司（CPP Investments）和安大略教师养老金计划（OTPP）。

在OTPP价值2200亿美元的投资组合中，私人资产有85%以直接投资者的方式获得，从彩票运营商到可再生能源设施不一而足。为增强投资能力，它打造了一支内部投资团队，现已有350人。“我们喜欢影响力，而且思考方式是以30年为限。对于大多数私募股权基金来说这都太久了。”首席执行官乔·泰勒（Jo Taylor）说。投资公司康桥汇世（Cambridge Associates）的安德烈亚·奥尔巴赫（Andrea Auerbach）估计，现在仅联合投资就占到大型机构投资者承诺出资的四分之一，而15年前只有10%。

除了给予投资者更多控制权外，直接投资和联合投资还可以提高回报。过去25年中，OTPP的直接投资带来了约20%的回报——位列前四分位，高于它通过基金做出的投资。摩根大通的迈克尔·森伯勒斯特（Michael Cembalest）表示，2009年至2016年间，约80%的联合投资的表现优于同期启动的基金。

回报更高并不奇怪。直接投资者和联合投资者不需要支付基金投资者要支付的费用：通常为1.5%到2%的管理费，以及20%的绩效费（即经理人的“附带权益”）。大量自由投资的机构可将“混合”管理费降至1%到1.5%。英

国820亿英镑（1100亿美元）的高校养老金计划（Universities Superannuation Scheme）的私募基金主管杰弗里·盖格（Geoffrey Geiger）表示，通过直接投资为其成员节省了“数亿美元”。麦肯锡的马特·波特纳（Matt Portner）说，与节省下来的费用相比，额外的员工成本不算什么。

| 划算吗？

GP对此心情矛盾。这种做法意味着损失了一些费用收入，但仍可能有用武之地。由于对单一持股份额的风险限制，如果没有联合投资者，一些基金将难以展开大笔投资。如果没有GIC等联合投资方，黑石及其合作伙伴将难以完成去年6月以340亿美元收购医疗用品巨头梅得朗（Medline）的交易。

大多数投资者支付的数字接近于人尽皆知的“2-20”模式。美国证监会主席盖瑞·根斯勒（Gary Gensler）去年表示，2018至2019财年的私募股权管理费和绩效费平均分别为1.76%和20.3%，“与1980年代我在华尔街时并无多大区别”。其他费用可能会在一只基金的整个生命周期内把包括“附带权益”在内的总体费用推高至每年5%或更多。这包括“监控”投资组合公司的费用、行政费用，甚至是使用私人飞机的费用。私人市场咨询公司StepStone对私募收费的描述令人印象深刻：“像雪花一般，漫天飞舞、独具特色、不够透明”。

LP没有为此大呼小叫，部分原因是它们害怕被排除在GP未来的新基金或联合投资机会之外。有些LP对此默不作声是因为它们另有附属协议来拿回扣。不过也还是有不少LP抱怨费用太高，而且即使基金表现参差不齐，收费模式却一成不变。还有一些抱怨收费是以全部承诺资本来计算，而不仅仅是对已经部署的资金。

一些GP试图安抚。一些已经转变为仅就已部署的资金收费。一家大型投资机构预测私募最终会步对冲基金的后尘：金融危机之后相对回报下降时，一些对冲基金关闭了，另一些变身为家族办公室，其余许多都降低了收费。

但“2-20”很可能会继续用作收费基准。芝加哥大学布斯商学院的史蒂文·卡普兰（Steven Kaplan）说：“收购和风投市场的配给方式是，表现不佳的基金的管理者很难募集到更多资金，它们会逐渐退出而不是通过降低收费来维持业务。”一家美国捐赠基金的私募股权投资组合主管表示，如果真有变化，那也是LP感到需要为优秀业绩支付超过20%的附带权益，而不是为低于平均的业绩支付少于20%。如果基金管理者能提供一些特别的东西，比如四倍于原始投资的回报，一些投资者愿意支付25%以上。

LP之所以没有大力要求降低收费的一个最大的原因，是它们相信非上市投资将继续跑赢公开市场。私募公司吹嘘过去20年炫目的高回报。分析了相关数据的学者意见不一——尽管不是对半分。以牛津大学赛义德商学院的卢多维克·法利普（Ludovic Phalippou）为首的少数派大声反驳说，私募的出色表现是一种错觉，是被一个已经擅长操纵数字的行业制造出来的幻象。法利普计算得出，过去十年它的回报仅仅与股市相当。GP坚称它回报更高的做法已构成“不当营销丑闻”。

其他学者大多不同意这一结论。他们承认私募行业喜欢使用的衡量标准“内部收益率”（IRR）有其缺陷：可以美化数字，比如在现金流上做些手脚，或者抽掉“认缴额度”（基金经理们从银行获得的贷款，以延后向LP发出缴纳资金通知）。但学者们已经制定出了更可靠的衡量标准。其中最好的是“直接阿尔法”（direct alpha），这是一种更不易被操纵、经市场调整的IRR版本。

北卡罗莱纳大学克南-弗拉格勒（Kenan-Flagler）商学院的私人资本研究所（Institute for Private Capital）1月发表了一篇论文，计算了在1986到2016年间组建的基金自1990年代中期以来的“直接阿尔法”。它发现，包括收购和风投在内的私募在所有时间跨度（三年、五年、十年、15和25年）中的表现都优于股票二至六个百分点。无论使用的是何种基准指数它都胜出：作者测试了MSCI全球指数、美股罗素3000指数以及一个小盘价值股指数，等等。

一个不太好的消息是表现差距缩小了。随着私人市场变得更拥挤，对优异

投资的竞争也愈发激烈。而随着这个行业越变越大，它也已领略到沃伦·巴菲特所言不虚：“世上没人能拿着大笔钱赚到20%”。该研究的主要作者格雷戈里·布朗（Gregory Brown）说，真正的问题是，一旦回报率经风险因素调整，私人资产是否还值得投资。私募的贝塔系数（相对于整体市场的风险）比股票高20%到30%。投资者也为流动性不足要求溢价（国际清算银行表示，共识是每年约三个百分点）。他们必须在流动性不足和持有私人资产的多元化收益之间权衡得失。

即使机构投资者最后得出结论说私募是有回报的，平均回报也只是个平均值。选择一个低于平均水平的基金，你就可能陷入亏损。最高和最低四分位的私募基金之间的业绩差距比公开市场的要大：在某些年份，差距达到15个百分点或更多。一位私人市场顾问估计，五分之一的私募投资是亏钱的。

由于过去和未来表现之间的联系减弱，挑选赢家变得更难了。詹金森说，随着行业规模扩大，如果一家私募公司有一只基金的业绩冲进前四分位，那它下一只基金也进入该行列的几率已逐渐降到了“比25%高不了多少”。而且关于过往业绩的信息常常都是不完整的：投资者必须在前一只基金开始投资的三四年后就决定是否支持该公司的下一只基金，而此时最终回报还远不明确。即使在私人市场的最上游，投资实质是坚持信念，而不只是研究业绩。■



Additive manufacturing

A new type of 3D printing may bring it into the mainstream

It is to the old version as the printing press is to the pen

EARLY FORMS of additive manufacturing, or 3D printing as it is popularly called, began to emerge in the 1980s. But it took more than a decade for the technology to start taking off. Initially, it was used to make prototypes. Now, intricate components are routinely 3D-printed in plastic and metal, for use in products ranging from jet engines and robots to cars.

Sales of 3D-printing services and machines grew by more than 17% in 2021, to reach around \$15bn, according to preliminary estimates for a report by Wohlers Associates, a firm that tracks the industry. However, as useful as additive manufacturing has become, it struggles to compete on cost and speed with more established ways of making things, such as injecting molten plastic into moulds or stamping out metal parts with a giant press.

As a result, most manufacturers use 3D printers to produce low-volume, high-value parts. The extra time and expense this takes can be worth it for certain items. Making things additively produces objects layer by layer, so tricky internal structures can be incorporated more easily into a design. Shapes can also be optimised for strength and lightness, saving materials. But what if these advantages could be had at the speed and cost of conventional factory processes? A new form of additive manufacturing aims to do just that.

The origin of this process, trademarked “Area Printing”, goes back to 2009. That was when James DeMuth, having finished his master’s degree in mechanical engineering at Stanford University, started work at the National Ignition Facility, part of the American Department of Energy’s Lawrence Livermore National Laboratory (LLNL). This uses some of the world’s most

powerful lasers to study nuclear fusion.

One of the challenges Mr DeMuth was given was to find a way to use a highly specialised type of steel to manufacture a 12-metre wide fusion chamber containing many complex features. He considered a form of 3D printing, called Laser Powder Bed Fusion (L-PBF), for the job. This employs a laser beam to weld together particles on a thin bed of powdered metal, to form the required shape of the object's first layer. Then more powder is added and a second layer is welded on top of the first. And so on, until the item is complete.

The problem is that, as with most other forms of 3D printing, there is an inverse relationship between resolution, which governs the level of detail that can be printed, and the speed of the process. Hence, some large components with fine details can take days, if not months, to print. Producing the chamber looked as if it might take decades. L-PBF was clearly unfeasible for such an application.

This got Mr DeMuth and a group of colleagues thinking about how to speed things up without compromising quality. After some work, they started using a device called an optically addressed light valve, which had been developed at LLNL. This permits a pulsed infrared laser, with its beam shaped to have a square cross-section, to be patterned with a high-resolution image. Working a bit like a photographic negative, the image can block or pass light, creating millions of tiny laser spots, much like the pixels that make up a digital image.

When projected onto a bed of powder, this patterned laser light can weld a complete area in one go. Mr DeMuth likens the process to producing documents with a printing press instead of writing them out individually with a pen.

| *Not such a dotty idea*

In 2015 Mr DeMuth co-founded Seurat Technologies, to commercialise the technology. This Massachusetts-based firm is named after Georges Seurat, a post-impressionist French artist who pioneered a painting style called pointillism that builds pictures up from dots. Several companies, including GM and Volkswagen, a pair of carmakers, Siemens Energy, a division of a large German group, and Denso, a big Japanese components firm, have partnered with Seurat to explore the use of its first prototype area-printing machine.

This prototype produces a series of small, patternable squares on the powder bed. Their size depends on the material. Aluminium requires 15mm squares. Titanium requires 13mm. Steel requires 10mm. Individually, these squares might seem small. But 40 of them can be printed adjacent to each other every second, so a large area can be covered quickly. The prototype was designed to work at this scale to keep the size of the laser and the amount of energy it consumes to a practical level.

With the equivalent of 2.4m pixels projected in each square, the machine can print parts with layers just 25 microns (millionths of a metre) thick at a rate of 3kg an hour. This is ten times faster than a typical L-PBF machine at such a fine resolution, says Mr DeMuth. Production versions of the area printer are now being built, and future generations of the machine should end up being 100 times faster.

All that, says Mr DeMuth, means area printing will be competitive with mass-production factory processes, such as machining, stamping and casting. As an example, he believes that by 2030 it will be possible to produce silverware (utensils that nowadays are made from stainless steel) for \$25 a kilo. "That means we could actually print silverware cheaper than you could stamp them out," he adds.

Other laser-based 3D printers are getting faster, too. L-PBF machines, for example, may be fitted with several beams—though the complexity involved could limit their number. And many non-laser ways to print things are improving as well, using all manner of materials to make items ranging from buildings to bridges to biscuits. One way or another, then, 3D printing seems at last to be ready to give traditional factories a run for their money. ■



增材制造

一种新型3D打印可能会将该技术带入主流

这种技术之于旧版，就像印刷机之于笔【新知】

增材制造有个通俗的名字叫3D打印，它的早期形式始于上世纪80年代。但这项技术经过十多年多才真正起步。起初，它被用于制作原型机。现在，人们已在常规化地使用3D打印制造复杂的塑料和金属部件，用于喷气发动机、机器人、汽车等各种产品。

追踪这一行业的公司Wohlers Associates在一份报告里初步估计，2021年3D打印服务和设备的销售额增长了17%以上，达到150亿美元左右。不过，尽管增材制造已变得很实用，但它在成本和速度方面仍难与更成熟的制造方式匹敌，比如注塑成型或是用巨型压力机冲压出金属零件。

因此，大多数制造商用3D打印机来生产数量少、价值高的部件。对于某些部件来说，多花些时间和费用是值得的。增材制造是逐层生成物件的，所以就更容易将复杂的内部结构整合成一整个设计。还可以优化形状以满足强度和轻巧度的要求，节省材料。但是，如果既能有这些优势，又能兼具传统工厂加工的速度和成本呢？一种新型增材制造就是要做到这一点。

这项注册名为“区域打印”的工艺可以追溯到2009年。当时詹姆斯·德穆思（James DeMuth）在斯坦福大学获得了机械工程硕士学位，开始为国家点火装置（National Ignition Facility）工作，该装置隶属于美国能源部的劳伦斯利弗莫尔国家实验室（Lawrence Livermore National Laboratory, LLNL）。它用世界上最强大的一些激光来研究核聚变。

德穆思接到的任务之一是要想办法用一种非常专门化的钢材建造一个12米宽的包含诸多复杂特征的聚变室。他考虑使用一种被称作激光粉末床熔合（Laser Powder Bed Fusion, L-PBF）的3D打印技术。它用激光束将薄薄一层金属粉末中的颗粒烧结在一起，形成物体第一层所需的形状。然后添加更多粉末，在第一层上面烧结第二层。以此类推，直至整个构造完成。

问题是，与大多数其他类型的3D打印一样，精度（可被打印的细节水平）和打印速度呈反比关系。因此，打印一些构造精细的大型组件可能需要几天甚至几个月。建造这个聚变室看起来要花上几十年。在这种情况下用L-PBF显然不可行。

这促使德穆思和他的一帮同事思考如何在不影响质量的情况下加快速度。一番研究之后，他们开始使用LLNL开发的一种设备，名叫光寻址光阀（optically addressed light valve）。这个设备让脉冲红外激光器发出的激光束（截面呈正方形）按照一幅高分辨率图像来构成图案。图像的作用有点像照相底片，可以阻挡激光或是让激光通过，从而产生数百万个微小的激光点，就像组成数字图像的像素一样。

当激光投射到一层粉末上时，按预定图像透过的激光可以一次性烧结一个完整的区域。德穆思将这一过程比作用印刷机生成大量文件，而不是用笔一份份写出来。

| 这点子可不疯

2015年德穆思和其他人一同创立了修拉科技（Seurat Technologies），将这项技术商业化。这家总部位于马萨诸塞州的公司以乔治·修拉（Georges Seurat）的名字命名。修拉是一位后印象派法国艺术家，他开创了一种叫做点彩的绘画风格，用点组成图画。有几家公司已经与修拉科技合作，共同探索使用其首款区域打印机的原型机，其中包括汽车制造商通用和大众，德国大型集团西门子的子公司西门子能源以及日本大型零部件公司电装（Denso）。

这个原型机在粉末层上生成一系列可以制作图案的小正方形。方形的大小取决于材料。铝需要15毫米的方形。钛需要13毫米。钢需要10毫米。这些正方形单个来看可能很小，但是每秒钟可以打印40个相互邻接的正方形，所以能快速覆盖大面积区域。该原型机以这种规模工作，就可以将所用激光器的大小和所消耗的能量保持在合理可行的水平上。

这台机器在每个正方形上投射了240万个激光点，以每小时3千克的速度、

每层仅25微米（百万分之一米）的厚度打印零件。德穆思说，在如此高的精度下，它比一般的L-PBF机器快10倍。这款区域打印机的量产机正在制作中，未来几代的机器应该会快100倍。

德穆思表示，这一切意味着区域印刷将能与大规模生产的工厂工艺竞争，如机械加工、冲压和铸造。比方说，他相信到2030年有可能以25美元一公斤的价格生产不锈钢餐具。“这意味着我们打印餐具的成本其实比冲压生产要低。”他补充道。

其他基于激光的3D打印机也越来越快。例如，L-PBF机器也许可以安装多个激光束——不过数量不能太多，不然结构就太复杂了。许多非激光的打印方法也在改进，用各种材料来制作从建筑、桥梁到饼干的各种东西。无论如何，3D打印似乎终于准备好与传统工厂竞争了。■



Everywhere, a Russian phenomenon

The inflationary consequences of Russia's war will spread

Inflation, already high, will go higher still. What will central banks do?

LAST SUMMER, amid mounting alarm about inflation in America, economic advisers in the White House penned a blog post in which they examined historical parallels. Although the press was full of comparisons with oil shocks in the 1970s, they wrote that a nearer relative was the dislocation after the second world war, when supply shortages interacted with pent-up demand. It was a well-reasoned argument. But the surge in commodity prices over the past month, in the wake of Russia's invasion of Ukraine, gives rise to an unsettling question: is the global economy now seeing a 1970s-style price shock on top of a late-1940s-style supply crunch?

To be sure, no serious economist expects inflation in the rich world to reach the giddy double-digit heights of those episodes. On March 16th the Federal Reserve raised interest rates for the first time since 2018, kicking off a tightening cycle that it expects to continue well into next year. Moreover, the retreat in oil markets in recent days could offer relief.

Nevertheless, surging prices for everything from wheat to nickel threaten to add to inflation. And rolling lockdowns in parts of China could exacerbate strains on global supply chains. Consumer-price inflation in America already stood at a 40-year high in February, at 7.9% year on year; the rate in the euro area, meanwhile, exceeded 5%.

Investors are still far from persuaded that central bankers are on top of the problem. The most striking evidence is the inflation expectations that can be found in fixed-income markets in America. ICE, a financial firm, distils a few different numbers, including yields on inflation-protected bonds and interest-rate swaps, into short-term and long-term indices for gauging

expectations. In late January the expected rate of inflation over the next year was 3.5%. On March 15th it stood at 5.4%. Expectations in the euro area have seen similar, if slightly steeper, trends. The one-year inflation swap rate rose to 5.9% on March 8th (see chart 2).

Markets are inherently volatile, so deriving inflation predictions from bond yields should be taken with a pinch of salt. But the shift in prices is broadly in line with what economists are forecasting. Earlier this month Bank of America raised its inflation forecasts for much of the world. In America it now expects inflation over 2022 as a whole to average 7%, up from its prior forecast of 6.3%. In the euro zone it sees an even bigger increase, with inflation averaging 6% this year, well above its previous forecast of 4.4%. The challenge is greater for Europe because of its high dependency on Russia, which supplies about 45% of its gas imports.

In an indication of just how pervasive the pressures are likely to be, economists are even ratcheting up their inflation forecasts for Japan, where deflation has long been the bigger threat. On March 8th S&P, a rating agency, said that Japanese inflation would average 2% this year, more than double its previous prediction. So far forecasters expect a relatively modest increase in overall inflation in emerging markets. But rising food costs will be especially damaging for their poorest citizens.

Two related questions emerge from these forecasts. The first is whether the rise in commodity prices today will feed through into lofty inflation in the longer run. There is, in fact, reason for cautious optimism. A large body of research shows that the pass-through from higher oil prices into non-energy inflation is quite limited. For instance, Goldman Sachs, a bank, calculates that a 10% increase in crude-oil prices leads to a jump of nearly three-tenths of a percentage point in headline inflation in America, but to an increase of just about three-hundredths of a percentage point in core inflation (stripping out food and energy prices). That helps explain why

market expectations of longer-term price trends remain more subdued: pricing for inflation five years from now is close to the Fed's goal of keeping inflation to an average of 2%.

The follow-up is what central bankers choose to do about rising commodity prices. The received wisdom of the past few decades is that policymakers should avoid over-tightening in the face of oil shocks. Indeed, surging energy prices can act as a drag on consumption, which is a particular concern for Europe.

But with real interest rates deeply negative in both America and Europe, central banks still have a long way to go to rein in inflation, whatever happens to commodity prices. On March 10th the European Central Bank surprised markets by announcing that it would wind down its bond-buying more quickly. And according to the Fed's projections, its quarter-point rate increase is likely to be the first of seven this year. Central banks are, for now, sticking to their pre-war plans. ■



俄罗斯打仗，全世界通胀

俄罗斯开战造成的通胀将四处蔓延

已经高企的通胀还会继续走高。各国央行会怎么做？

去年夏天，对美国通胀的担忧日益加剧，白宫的经济顾问写了一篇博客，研究了历史上相似的情形。尽管媒体都在拿上世纪70年代的石油冲击做比较，但这篇文章认为，与这次情况更接近的是二战后的供需错配，当时供应短缺遇上了积压的需求释放。这个观点理据充分。但在俄罗斯入侵乌克兰之后的一个月里，大宗商品价格飙升，引出了一个令人不安的问题：现在全球经济是否面对上世纪40年代后期那种供应紧缩叠加70年代式的价格冲击？

可以肯定的是，没有哪个严肃的经济学家认为富裕国家的通胀会升到那两个时期令人晕眩的两位数字的高位。3月16日，美联储自2018年以来首次加息，开启了预计将持续到明年的紧缩周期。此外，近日石油价格回落，可能会让人松一口气。

然而，从小麦到镍的各种商品的价格都在飙升，可能会加剧通胀。中国部分地区轮番封锁，可能会加大全球供应链的压力。美国2月的消费价格通胀已经达到40年来的最高，同比增长7.9%；与此同时，欧元区的消费通胀超过了5%。

投资者目前还根本不信服央行官员们已经控制住了局面。最明显的证据是美国固定收益市场的通胀预期。金融公司ICE将一些不同的数据（包括通胀保值债券和利率掉期的收益率）提炼成用于衡量通胀预期的短期和长期指数。在1月底，对下一年的通胀预期为3.5%。3月15日的预期为5.4%。欧元区的预期也出现了类似的趋势，升势还更加陡峭一点。3月8日，一年期通胀掉期利率升至5.9%（图表2）。

市场天生就有波动，因此应该谨慎看待从债券收益率推导出的通胀预测。但价格的变化大体上与经济学家的预测一致。本月稍早时，美国银行

（Bank of America）提高了对世界大部分地区的通胀预期。该行现在预计2022年美国全年的平均通胀将达到7%，高于之前预测的6.3%。欧元区的升幅更大，今年平均通胀预期为6%，远高于此前预测的4.4%。欧洲面临的挑战更大，因为它高度依赖俄罗斯，45%的天然气要从俄罗斯进口。

经济学家们甚至提高了对日本的通胀预期，而在日本更大的威胁一直都是通缩，由此也可见通胀压力是多么普遍。3月8日，评级机构标普表示，日本今年的平均通胀将达到2%，是它之前预测的两倍多。到目前为止，预测机构预计新兴市场的总体通胀将相对温和。但不断上涨的食物成本会对这些国家最贫穷的民众带来尤其大的伤害。

从这些预测中浮现出两个相互关联的问题。首先，今天大宗商品价格的上涨是否会在更长的时期内推动通胀上行。事实上，人们有理由保持谨慎乐观。大量研究表明，高油价对非能源通胀的传导作用非常有限。例如，根据高盛的计算，原油价格上涨10%，会导致美国总体通胀上升近0.3%，但核心通胀（剔除食品和能源价格）只会增加约0.03%。这有助于解释为何市场对长期价格趋势的预期仍然更为低迷——对五年后的通胀定价接近美联储将平均通胀保持在2%的目标。

接下来的问题是央行官员选择以什么方式应对大宗商品价格的上涨。过去几十年的普遍看法是，面对石油冲击，政策制定者应避免过度紧缩。事实上，飙升的能源价格可能拖累消费，而这是欧洲特别关注的问题。

但由于美国和欧洲的实际利率都深处负值，无论大宗商品价格如何变化，各国央行在控制通胀方面仍有很长的路要走。3月10日，欧洲央行宣布将加速缩减购债，令市场意外。根据美联储的预测，今年首次加息0.25%之后可能还会加息六次。目前而言，各国央行仍在坚持贯彻它们在俄乌战争之前制定的计划。 ■



Russia and Ukraine

Daniel Yergin on Russia losing its status as an “energy superpower”

The energy analyst and award-winning author of “The Prize” and “The New Map” says Vladimir Putin is destroying the foundation of his country’s economic power

VLADIMIR PUTIN once said that he did not like hearing Russia described as an “energy superpower”. It reminded him, he said, too much of the cold war. But he has revelled in what his country’s energy resources have brought him—global political clout and massive revenues. But the consequences of the Ukraine war will turn Russia into a “reduced energy power”.

This marks the end of an era that began three decades ago with the collapse of the Soviet Union. In the years afterwards, for the first time since the Bolshevik revolution, the Russian oil industry rebounded and largely integrated with the global industry. Today Russia is one of the top three oil producers in the world (after America and roughly equal with Saudi Arabia) and is also the world’s largest natural-gas exporter and second-largest producer, again after America.

In just a few weeks, Mr Putin has destroyed the internationalised economy he has been building for more than 20 years, as well as the reputation Russia has cultivated as a reliable supplier. It is now seen as an unreliable and largely unwanted energy source for Europe. In 2021 it supplied 29% of Europe’s total gas supplies and 35% of its oil. Although it remains a necessary supplier for now, its role is certain to diminish.

Unplugging Russia from the world economy with massive sanctions turns out to be a challenge. As an exporter, it is mainly a supplier of commodities and raw materials, none of them easily replaceable in an inflationary time. Oil and gas rank at the top of the list, accounting for half of total export

earnings and, in some years, over 40% of Russia's total budget.

Europe's immediate need, now that winter is ending, is to ensure enough natural gas in storage for next winter, and for that it will need Russian supplies. Overall, however, Russia's gas sales to Europe will shrink dramatically over the next five years. Europe will step up its push towards renewables, now for reasons of security as well as climate change. France has announced new nuclear power plants, and Europe is searching the world for more liquefied natural gas (LNG).

That market is tight, but America will be bringing on more capacity this year, making it the world's largest LNG exporter. Europe will promote energy efficiency but also burn more coal, at least temporarily. The roll-out of electric vehicles will accelerate. Europe will need to expedite permission for new oil and gas production. "Yet-to-find" natural gas resources in Europe are estimated to be equivalent to decades worth of Russian gas exports to the continent. Russia will be able to pipe more to China, but will be stuck with a westward-running pipeline system into Europe operating far below capacity.

In a normal year, Russian oil exports generate more than three times the revenues of gas. But its oil exports are, so far, much more disrupted. About half of Russia's 7.5m barrels per day of exports go to Europe. Though those exports were explicitly excluded from formal sanctions (until they were specifically targeted by America and Britain), they are being indirectly sanctioned and "self-sanctioned" by buyers, shippers, and insurance providers, as well as by the extreme reluctance of banks to provide trade finance. A new factor is now shaping oil markets: the force of public opinion horrified by the war in Ukraine and the resulting pressure on companies to step back from Russian oil.

This creates a dilemma for European countries: not buying Russian oil in

response to a public enraged by the devastation in Ukraine, set against likely fuel shortages across the continent. Mr Putin thought he had leverage, launching the war when energy markets were very tight, expecting that EU countries would protest but stand aside. But this has proved a serious miscalculation. At this point it appears that Russian tanker loadings are down by 1-2m barrels per day, and additional barrels are stuck at sea, unable to find a home.

Western governments, having rediscovered the concept of energy security, are scouring the world for additional supplies. They should plan on the basis that either the rejection of Russian oil will increase or that Mr Putin will wield the “oil weapon” and cut supplies. Whichever it is, they should be working much more closely with oil and gas companies to understand the changing logistics. To facilitate collaboration, they would do well to put aside the customary populist language about market manipulation usually invoked when prices go up.

This brings us to the question of fungibility, that strange word describing the ease (or not) of replacing one good with another. In theory, the oil market will readjust. Russian barrels no longer bound for Europe would go somewhere else, mainly to Asia, and barrels from elsewhere would come to Europe. Buyer countries such as India, which imports 85% of its oil, and China, will be eager to buy heavily-discounted Russian oil. But the complex system that moves about 100m barrels a day around the world is not easily rebalanced and will be snarled by new frictions, such as the difficulties of arranging finance and transport from Black Sea and Baltic ports, and the new sanctions. Bilateral payment systems that avoid the dollar would be needed, and barter may well return.

The OPEC-plus system, managed by Saudi Arabia and Russia, worked in a globalised market. But it will be difficult to hold together in a more Balkanised world in which countries will find it harder to “abstain” from

choosing sides as they did in the recent UN vote condemning the invasion. Adding to the tension among exporters, countries in the Middle East will find themselves competing in the Asian market against an onslaught of cheaper Russian oil.

The investments that western companies made in Russian energy over the past three decades were strongly encouraged by Western governments, which wanted to undergird the post-Soviet relationship with an economic foundation and, after the Gulf crisis of the early 1990s, bring more diverse supplies into the global market. Those companies are now leaving their investments in Russia. Companies from emerging markets will try to pick up the abandoned properties at bargain prices, while needing to take care to skirt sanctions. Russian energy companies are now cut off from international finance and flows of technology. All of this will mean that Russian oil and natural-gas production will decrease.

Mr Putin launched the war on the claim of “unity”, that Russians and Ukrainians are “one people”, and as an important step to achieve his grand ambition to reassert Russia as a great power. But what he has done, in addition to shattering any such unity, is to undermine and debase Russia’s most important source of economic power.

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俄罗斯与乌克兰

丹尼尔·耶金谈俄罗斯丧失“能源超级大国”地位

这位能源分析师、《石油风云》和《新版图》的获奖作者表示，普京正在摧毁俄罗斯经济力量的基础

普京曾说自己不喜欢听到人们叫俄罗斯“能源超级大国”。他说这太容易唤起自己对冷战的回忆。话虽如此，他却陶醉于俄罗斯的能源资源给自己带来的好处——全球政治影响力和巨额收入。但乌克兰战争将把俄罗斯变成一个“衰落的能源大国”。

这标志着一个时代的结束，这个时代开始于30年前的苏联解体。在之后的那些年里，俄罗斯石油工业出现了自布尔什维克革命以来的首次复兴，并在很大程度上与全球石油工业融为一体。如今，俄罗斯是世界三大石油生产国之一（仅次于美国，与沙特阿拉伯相当），也是世界上最大的天然气出口国以及同样仅次于美国的第二大天然气生产国。

就在短短几周内，普京不仅毁掉了俄罗斯树立的可靠能源供应国的声誉，也毁掉了他20多年来一直在打造的国际化经济。在欧洲眼里，如今的俄罗斯是一个不可靠且基本上不受欢迎的能源来源国。2021年，俄罗斯的天然气和石油分别占到欧洲供应总量的29%和35%。尽管目前俄罗斯仍是必不可少的能源供应国，但它的作用肯定会减弱。

事实证明，通过大规模制裁把俄罗斯从世界经济体系中剥离并非易事。作为出口国，俄罗斯主要供应大宗商品和原材料，这些在通胀时期都不容易被替代。位居出口商品榜首的石油和天然气占到俄罗斯出口总收益的一半，在某些年份会贡献它总预算的40%以上。

由于这个冬天即将过去，欧洲的当务之急是确保为下一个冬天储存足够的天然气，这将需要俄罗斯的供应。不过，总体而言，未来五年俄罗斯对欧洲的天然气销量将大幅减少。欧洲将加快推进可再生能源的发展，这既是因为气候变化也是出于安全原因。法国已宣布新建多个核电站，欧洲正在

全球寻找更多的液化天然气（LNG）。

LNG市场供应紧张，不过美国今年将加大产能，成为世界上最大的LNG出口国。欧洲将提高能源效率，但也会燃烧更多的煤炭——至少暂时如此。电动汽车的普及将提速。欧洲将需要加快批准新的石油和天然气生产项目。据估计，欧洲“尚待发现”的天然气资源相当于俄罗斯几十年的对欧出口量。俄罗斯未来能够通过管道向中国输送更多天然气，但它向西延伸到欧洲的管道系统却会摆脱不了远低于运能运营的命运。

在正常年份，俄罗斯石油的出口收入是天然气的三倍多。但目前为止，它的石油出口受到的影响要大得多。俄罗斯每天出口的750万桶石油中约有一半流向欧洲。尽管这些出口石油起初被明确排除在正式制裁之外（后来被美国和英国专门列为制裁对象），但它们正受到来自买家、航运公司以及保险供应商的间接制裁和“自发制裁”，银行极不愿意为它们提供贸易融资也属于这种制裁。一个新的因素正在塑造石油市场：被乌克兰战争震惊的舆论的力量，以及企业由此受到压力要摆脱俄罗斯石油。

这让欧洲国家进退两难：若回应乌克兰灾难激起的民众怒火而不购买俄罗斯石油，就要面对整个欧洲大陆很可能会出现燃料短缺。普京认为自己手握筹码，在能源市场非常吃紧的时候发动战争，预计欧盟国家会做些抗议但最终袖手旁观。但事实证明这是个严重的误判。眼下，俄罗斯油轮的日装载量似乎减少了一两百万桶，还有很多桶石油被困海上，无处可去。

西方各国政府对能源安全的概念有了重新认识，正在满世界地寻找额外的供应。它们制定计划时应基于这样一种基本认知：要么人们会进一步拒绝俄罗斯石油，要么普京会动用“石油武器”削减供应。不管哪一种情况，它们都应该与石油和天然气公司更密切地合作，以了解不断变化的能源运输供给。为促进合作，它们最好还是把那些民粹主义的套话放到一边，不要动不动就把油气价格上涨说成是市场操纵所致。

这就引出了“可替换性”的问题，这个有点古怪的词说的是一种商品是否容易被另一种商品所替代。理论上，石油市场会重新洗牌。不再供应欧洲的

俄罗斯石油会被运往以亚洲为首的其他地方，而其他地方的石油会进入欧洲。印度（85%的石油都靠进口）和中国等采购国会很乐意购买大幅打折的俄罗斯石油。然而，这个每天在全世界运输约一亿桶石油的复杂系统要实现再平衡可没那么容易，并且还会受困于新的阻力，比如资金安排的困难，以及从黑海和波罗的海各港口运输的困难等，还有各种新制裁。将需要建立起避开美元的双边支付系统，物物交换很可能会再度兴起。

过去，由沙特阿拉伯和俄罗斯主导的欧佩克+体系在全球化的石油市场中发挥了作用。但在一个更加巴尔干化的世界里，该体系会更难以协同一致，因为各国会发现更难“避免”选边站，就像不久前它们在联合国谴责俄罗斯入侵乌克兰的投票中所做的那样。让石油出口国之间的关系更趋紧张的是，中东国家会发现自己还要在亚洲与滚滚而来的更便宜的俄罗斯石油争夺市场。

过去30年里，西方企业在俄罗斯能源领域的投资得到了西方政府的大力鼓励，政府希望用一种经济基础来巩固苏联解体后与俄罗斯的关系，并且在上世纪90年代初的海湾危机后让全球市场的供应更加多样化。如今这些西方企业正在放弃在俄罗斯的投资。新兴市场的企业将试图以低价收购这些被舍弃的资产，同时需要小心规避制裁。现在俄罗斯的能源公司与国际金融的联系以及技术交流被切断了。所有这些都意味着俄罗斯石油和天然气的产量将会下降。

普京发动这场战争，是以“统一”之名，即俄罗斯人和乌克兰人属于“同一个民族”，并且也是实现他重新确立俄罗斯大国地位的宏图大志的重要一步。但他的所作所为，除了粉碎任何此类统一之外，也将破坏和贬损俄罗斯经济力量最重要的来源。

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Buttonwood

Can foreign-currency reserves be sanctions-proofed?

The war will be as formative for reserve managers as the Asian financial crisis was

CRYPTO INVESTORS sometimes say they have been “rugged” when the developers of a coin vanish, along with the capital that has been allocated to it, pulling the rug out from under them. Foreign-exchange reserve managers might never have expected to recognise the feeling. But almost as soon as Russia invaded Ukraine, American and European authorities froze the assets of the Central Bank of Russia. As others followed, the country’s first line of financial defence was obliterated. According to the Russian government, \$300bn of its \$630bn in reserves are now unusable.

The managers of the \$13.7trn in global foreign-exchange reserves are a conservative breed. They care about liquidity and safety above all else, largely to the exclusion of profits. Much of their thinking was shaped by the Asian financial crisis of 1997-98, when currencies collapsed in the face of huge capital outflows. The lesson learned was that reserves needed to be plentiful and liquid.

Watching a big chunk of Russia’s reserves being made functionally useless is likely to be just as formative, even for those who face no immediate prospect of a terminal rift with the world’s financial superpowers. That is particularly true for the State Administration of Foreign Exchange (SAFE), the agency in charge of China’s \$3.4trn in reserves. India and Saudi Arabia, with \$632bn and \$441bn in reserves, respectively, may also be paying close attention.

Barry Eichengreen, an economic historian, has described the choice of the composition of foreign-exchange reserves as being guided by either a “Mercury” or a “Mars” principle. The Mercurial approach bases reserves on

commercial links; the currencies being held are largely determined by their usefulness for trade and finance. A Martian strategy bases the composition more on factors like security and geopolitical alliances.

Mars seems to be in the ascendant. Central banks are bound to take into account which countries will and will not replicate sanctions against them. In 2020 Guan Tao, a former SAFE official now at Bank of China International, laid out a range of ways that China could guard against the risk of sanctions. In extremis, he suggested that the dollar could stop being used as the anchor currency for foreign-exchange management and be replaced by a basket of currencies.

Even that option, which might have sounded extreme a month ago, now falls short of what a Martian central bank would need, given the degree of co-operation with American sanctions. There are few, if any, jurisdictions with large, liquid capital markets denominated in currencies that are useful in an emergency, but which do not pose a risk from a sanctions perspective. Some worried central banks might start increasing their holdings of yuan assets (which currently make up less than 3% of the global total). But that is no solution for China itself.

Why not go back to basics? Gold, the original reserve asset, is a large liquid market outside any one jurisdiction's control. Researchers at Citigroup, a bank, estimate that most of the reserves that Russia can currently marshal are in gold and the Chinese yuan. Yet the West's sanctions are so expansive that they prohibit many potential buyers from purchasing the assets Russia has accumulated over the years. Even a would-be counterparty in a neutral or friendly country will think twice about transacting with a central bank under sanctions, if it risks their own access to the financial plumbing of the dollar system.

There has been more adventurous speculation, too. Zoltan Pozsar of Credit

Suisse, a bank, has suggested that China sell Treasuries in order to lease ships and buy up Russian commodities, arguing that the global monetary system is shifting from one backed by government bonds to one that is backed by commodities. Bold as the forecast is, it is also emblematic of the few conventional options available to reserve managers.

And that lack of good solutions points to another drastic approach: that countries limit their use of reserves for their financial defence altogether. Various tools of autarky, such as tighter capital controls, could become more attractive. Governments also typically rely on reserves as the last guarantee that they can service foreign-currency debts. But if that guarantee is no longer absolute, then they are less likely to be comfortable issuing dollar- and euro-denominated bonds at all. Private companies may be prodded to de-dollarise, too. If you don't invest in the first place, you won't be rugged. ■



梧桐

外汇储备能否不受制裁影响？

对外汇储备管理机构而言，俄乌战争将和亚洲金融危机一样具塑造作用

加密货币投资者有时候会用“脚下抽毯”（rugged）来形容加密货币的开发者连同配置在上面的资本一并消失时的感受。外汇储备管理机构也许从没想过有一天自己会对此感同身受。然而，几乎在俄罗斯刚一入侵乌克兰，美国和欧洲各国政府就冻结了俄罗斯央行的资产。随着其他国家跟进，俄罗斯的第一道金融防线被击破。俄政府表示，其6300亿美元的外汇储备中现有3000亿美元被冻结。

全球总值13.7万亿美元的外汇储备的管理者是个保守的群体。它们最关心的是流动性和安全性，基本不考虑利润。这样的想法大多是在1997年至1998年亚洲金融危机的影响之下形成的，当时由于资本大量外流，汇率崩盘。从中得到的教训是，外汇储备要充足且具有流动性。

眼看着俄罗斯外汇储备有一大块动弹不得，很可能会产生同样的塑造作用，即使对那些并没有即刻与金融超级大国决裂的风险的国家也一样。对管理着中国3.4万亿美元储备的国家外汇管理局就更是如此。分别拥有6320亿美元和4410亿美元储备的印度和沙特阿拉伯可能也在密切关注事态发展。

经济史学家巴里·艾肯格林（Barry Eichengreen）把外汇储备的配置方式分成两类：一种按“水星”原则，另一种按“火星”原则。前者会根据商贸联系来配置储备，持有各种外汇的多少主要取决于它们对贸易和金融的作用。后者更多根据安全和地缘政治联盟等因素来做配置。

火星式配置似乎愈发占上风了。各国央行现在势必要考虑哪些国家会对本国实施类似的制裁，哪些不会。国家外汇管理局前官员、目前在中银国际证券任职的管涛在2020年提出过一系列帮助中国防御制裁风险的方法。他建议，在极端情况下不再以美元作为外汇管理的锚定货币，改以一揽子货

币取代。

这个提议在一个月前听起来可能还显得偏激，但鉴于各方对美国制裁的配合程度，现在连这个方案也难以满足“火星式”央行的需求了。世界上极少有（如果真有的话）这样的司法辖区：拥有高流动性的大型资本市场，而其中的计价货币既可以在紧急情况下使用，又没有制裁风险。有人担心各国央行可能会开始增持人民币资产（目前在全球储备总额占比不到3%）。但这对中国自己来说不是个解决办法。

何不回归本原？最早的储备资产黄金就是一个不受任何司法辖区控制、有高流动性的大型市场。花旗集团的研究人员估计，俄罗斯目前能够调集的大部分储备是黄金和人民币资产。然而西方制裁覆盖如此广泛，阻止了许多潜在买家购入俄罗斯积累多年的资产。假如与受制裁央行进行交易会危及自己使用美元体系的金融管道，即使是中立或友好国家的潜在交易方也会犹豫再三。

也有更冒险的推测。瑞士信贷的分析师佐尔坦·鲍兹（Zoltan Pozsar）建议中国出售美国国债来租赁船舶和大举购入俄罗斯大宗商品，理由是全球货币体系正逐渐从由政府债券支撑转向由大宗商品支撑。这样的预测固然大胆，但也表明储备管理机构的常规选项不多。

既然没什么妙计可施，就指向了另一个极端的方案：各国干脆减少使用储备作为金融防御工具。收紧资本管制等各种封闭自立的手段可能会变得更有吸引力。各国政府通常还依赖储备作为偿还外币债务的最后保证。但如果这种保证不再是绝对的，那么各国就不太可能继续放心发行美元和欧元计价的债券。私营公司也可能被催促去美元化。只要一一开始不投入，你就不会被“脚下抽毯”。■



Medical technology

An artificial nose may be able to detect Parkinson's disease early

The inspiration came from the strange case of a retired nurse

PARKINSON'S DISEASE is a progressive neurological disorder caused by the deaths of neurons in parts of the brain called the substantia nigra. Symptoms include loss of motor control, mood disturbance, ruined sleep and altered sense of smell. It is incurable. Early medical intervention can, however, relieve these symptoms and prolong survival. That makes prompt diagnosis desirable.

Unfortunately, the initial signs of Parkinson's vary from person to person and there is no specific test at this early stage which can reliably distinguish it from other brain illnesses. It therefore often goes undetected until clear and characteristic manifestations, such as tremors and slowed body movement, appear. But that may soon change. A study published in ACS Omega, by Chen Xing and Liu Jun at Zhejiang University, in China, describes an invention which may be able to detect Parkinson's before the onset of tremulousness. The device in question is an artificially intelligent electronic nose.

| *A whiff of trouble*

The quest the two researchers embarked on to build this nose began in 2019. That was when they heard reports of Joy Milne, a retired nurse living in Scotland, who could detect people with Parkinson's from a distinctive odour they emitted—distinctive to her, at least, though for reasons still obscure, undetectable by others.

Mrs Milne first noticed this odour when her husband developed the illness. She made the general connection later, when she smelled it at sufferers' support groups attended by her spouse. Tests using clothes worn by

patients confirmed her ability. She even noted one seemingly healthy individual as having the disease months before other symptoms developed.

Carting Mrs Milne around the world to sniff patients who may have Parkinson's is, however, not a practical option, so researchers working with her looked for the odour's source, with a view to detecting it in some other way. They found it in sebum, an oily secretion produced by the skin. The sebum of those with Parkinson's, they discovered, has unusually high concentrations of certain volatile organic compounds, including dodecane, acetone and ethyl acetate. When these are acted on by yeast cells which live naturally on the skin, the result is the mysterious odour.

This Parkinson's-specific list can be detected using a laboratory technique called gas chromatography-mass spectrometry (GCMS), which is promising—for GCMS machines are a bit more deployable than Mrs Milne is. Unfortunately, they are still too complex and expensive to be used routinely in clinics. However, Dr Chen and Dr Liu, who are both biomedical engineers, reckoned they could come up with a cheaper and more portable alternative.

The upshot is a machine not much bigger than a toaster. It turns a sample of sebum into a vapour that is then probed with sound waves. Different molecular mixtures have different effects on the waves, and, with a bit of training, a computer loaded with an appropriate piece of artificial intelligence can learn to recognise the pattern associated with sebum from Parkinson's patients.

The researchers tested their system on samples from 43 people with Parkinson's disease and 44 who were healthy. They found it could correctly identify a Parkinson's patient as having the disease about 70% of the time and a healthy control as being clear of it about 80%. That is not yet as good as Mrs Milne's nose, which has a history of correctly identifying the

presence of Parkinson's all the time. But it is a start. If its reliability can be improved, the compactness and potential cheapness of the system Dr Chen and Dr Liu have come up with may eventually prove a boon for the early diagnosis of the illness. ■



医疗技术

一种人工鼻子或许能一早嗅出帕金森病

灵感来自一位退休护士的奇特本领【新知】

帕金森病是一种因脑内黑质区域中神经元的死亡引起的进行性神经失调。其症状包括运动控制丧失、情绪紊乱、睡眠障碍和嗅觉改变。它无法治愈。但是尽早施加医疗干预可以缓解症状，延长生存期。这就使得及早确诊很有益处。

不幸的是，帕金森病的最初症状因人而异，在发病的早期阶段，还没有哪种专门检测能可靠地将它和其他脑部疾病区分开来。因此它经常要等到出现明显且典型的临床表现，如颤抖和身体动作迟缓，才会被确诊。但这种情况可能很快就会改变了。浙江大学的陈星和刘军发表在《ACS Omega》期刊上的研究介绍了一项发明，或许能在震颤的症状出现前就检测出帕金森病。这款设备是一个人工智能电子鼻。

| 一丝麻烦的气息

两位研究人员制造这个电子鼻的探索始于2019年。当时他们听到有报道称，住在苏格兰的退休护士乔伊·米尔恩（Joy Milne）能闻到帕金森患者散发出的一种特殊气味，从而发现患病者。这种气味至少对她来说是特殊的，不过其他人无法察觉，原因不明。

米尔恩第一次注意到这种气味是在她丈夫患病之后。后来，当她在丈夫参加的患者支持小组里闻到这种气味时，才意识到普遍的关联。用病人穿过的衣服进行的测试证实了她的能力。她甚至指出一个看似健康的人已经得病了，而此人要在几个月后才出现其他症状。

不过，让米尔恩满世界去嗅出帕金森患者并不可行，所以研究人员和她一同寻找这种气味的来源，以期之后用其他方法来探测到它。他们在皮肤产生的一种油性分泌物皮脂中发现了这种气味。他们发现，帕金森病患者的皮脂中某些挥发性有机化合物的浓度异常地高，包括十二烷、丙酮和乙酸

乙酯。当皮肤上自然存在的酵母细胞对它们起作用时，就会产生这种神秘的气味。

这个帕金森病专有的物质清单可以用一种叫做气相色谱质谱联用（GCMS）的实验室技术检测出来，这就很有希望了，因为部署这种机器总比让米尔恩到处跑容易一些。遗憾的是，它们仍然过于复杂和昂贵，不能用作诊所的常规设备。不过，生物医学工程师陈星和刘军认为他们可以构造出更便宜也更便携的替代仪器。

他们的成果是一台比烤面包机大不了多少的机器。它将一份皮脂样本转化为蒸汽，然后用声波探测。不同的分子混合物对声波有不同的影响，在稍加训练后，一台配备有恰当的人工智能的电脑就能学会识别与帕金森患者的皮脂相关联的模式。

研究人员对43名帕金森患者和44名健康受试者的样本进行了测试。他们发现，在病患组，70%的情况下该系统可以正确识别出患者，而在健康对照组，80%的情况下它可以排除掉未患病的受试者。这比不上米尔恩的鼻子——米尔恩一直以来识别帕金森患者的正确率是百分之百。但这只是一个开始。如果能提升可信度，那么陈星和刘军发明的这个小巧简洁、可能还会很便宜的系统或许最终会成为帕金森病早期诊断的一大福音。■



Buttonwood

Iran's flourishing stockmarket reflects its resilient economy

The economy was hurt badly by sanctions but did not collapse

AS ONE DOOR slams shut, another creaks open. In the past fortnight the global pressure on Russia's finances has increased dramatically. Meanwhile, in Iran, the grip of sanctions is set to be relaxed again. In 2018 America withdrew from a multilateral nuclear accord with Iran. A year-long negotiation to revive it has moved to the final stages. A deal appears close. It is not unhelpful to its chances that an accord would bring Iranian oil back to the global market.

Iran's experience is instructive. In the past decade it has suffered recessions, devaluations and chronic inflation under the pressure of worldwide sanctions. Its economy has been whacked. But it has not collapsed. That is in large part because Iran's manufacturers have proved resilient. Tehran's flourishing stockmarket is testimony to the economy's hardiness. Many of the firms that have survived and prospered are listed there.

American sanctions have been a fact of life in Iran for decades. They began in 1979 when President Jimmy Carter imposed a ban on imports of oil from Iran and froze Iranian assets held in America following the seizure of the American embassy in Tehran. But sanctions on Iran really started to bite when other countries joined in. To press Iran into curbing its nuclear programme, a wave of international sanctions was imposed and steadily tightened between 2010 and 2012. Iran's oil exports and banks were targeted. The foreign assets of its central bank were frozen. And commercial banks worldwide were proscribed by America from financing any business with Iran in dollars. Since then, a sanctions regime of varying degrees of severity has remained in place.

The damage has been extensive. Iran's oil exports fell from 2.5m barrels per day in 2011 to 1.1m in 2014. Its economy suffered deep recessions in 2012 and 2018. The embargo on Iran's oil exports left a large hole in government finances. Lacking access to its reserves or reliable dollar revenue from oil exports, the authorities have been unable to support the exchange rate. The result has been chronically high inflation. There has been a lot of hardship. The latest World Bank report on Iran refers to a lost decade of negligible GDP growth. It might have been a lot worse, though.

There are three explanations for Iran's resilience. First, though sanctions have been extensive and assiduously policed, they are subject to leakage. Iran has been able to export several hundred thousand barrels of oil a day. Much of it ends up in China, marked as oil from Malaysia, Oman or the United Arab Emirates (UAE). Sanctions-busting is risky. But some privately owned refiners are willing to take the risk in exchange for a hefty price discount. And dollars are not the only hard currency: there is the yuan, of course, but also the UAE's dollar-pegged dirham.

A second source of resilience is export diversification. Iran has a range of manufacturing industries. Some of the bigger ones, such as mining and metal-bashing, benefit from access to cheap, reliable energy. In addition Iran has land borders with several populous countries, including Pakistan and Turkey. A chunk of Iran's land-based trade is undocumented and thus hard to police.

A third factor is import substitution. The weaker rial has put imported goods beyond the reach of many Iranians. But it has been a boon for manufacturers serving the home market of 83m. Go shopping in Tehran, says a local, and you will find Iranian-made clothing, toys and household goods. "If there were a global self-sufficiency index, Iran would be ranked highly," he says.

Iran's stockmarket reflects this resilient economy. Some of the larger firms are on the sanctions list, but hundreds of smaller ones are not. Stocks have proved a good hedge against devaluation and inflation. Many locals have noticed this. The market exploded in 2020 as retail investors piled in. That mini-bubble has since burst. Stocks are cheap again, says Maciej Wojtal of Amtelon Capital, a fund that invests in Iran. The median price-to-earnings ratio for the top 100 companies is around five, based on the forecasts of local analysts.

Iran's leaders have boasted of a "resistance economy". But its hardiness mostly reflects a bottom-up struggle for basic survival, not a top-down strategic choice, argues Esfandiyar Batmanghelidj of Bourse & Bazaar, a think-tank, in a recent essay. Economies are made up of ordinary people. They adapt to changed circumstances the best they can. For Iranians, there is now a real prospect of better days ahead. For the Russian people, the painful adjustment is just beginning. ■



梧桐

从伊朗的股市繁荣看它的经济韧性

伊朗经济受到制裁重创，但并未崩溃

一扇门砰然关闭时，另一扇却悄然打开。过去几周里，俄罗斯财政遭受的来自全球的压力急剧加码。与此同时，对伊朗的制裁眼看将再次放松。美国于2018年退出了与伊朗的多边核协议。现在，历时一年的恢复伊核协议的谈判已经进入最后阶段。似乎很快将达成协议。这对伊朗石油回归全球市场不无帮助。

伊朗的经验很有启发性。过去十年里，伊朗在全球制裁的重压之下遭受了经济衰退、货币贬值和长期通胀。伊朗经济受到重创，但并未崩溃。这在很大程度上要归功于伊朗制造企业表现出了韧性。德黑兰股市的繁荣证明了这个经济体的坚韧。许多坚持下来并蓬勃发展的公司都在这里挂牌上市。

几十年来，美国的制裁是伊朗无可改变的现实。1979年，美国驻德黑兰大使馆被占领，时任美国总统卡特下令禁止从伊朗进口石油，并冻结了伊朗在美国的资产。但当其他国家加入对伊制裁的队伍后，痛苦才真正开始显现。为了迫使伊朗限制其核计划，国际社会对伊朗实施了一轮制裁，并在2010至2012年间逐步加大力度。伊朗的石油出口和银行成为制裁的目标。伊朗央行在外国的资产被冻结。此外，美国还禁止世界各地的商业银行用美元为与伊朗的任何生意往来融资。自此，尽管严厉程度时有变化，但制裁一直在持续。

打击是广泛的。伊朗的石油出口量从2011年的每天250万桶下降到2014年的110万桶。伊朗经济在2012和2018年遭遇了严重衰退。对伊朗石油的出口禁运给政府财政造成了巨大的赤字。由于无法动用外汇储备，也无法通过石油出口获得可靠的美元收入，政府无力支撑汇率。结果就是通胀长期高企。伊朗饱尝艰困。世界银行关于伊朗的最新报告指出，该国经历了失落的十年，期间GDP的增长微不足道。不过，情况本来可能会糟糕得多。

对伊朗的经济韧性有三个解释。首先，尽管制裁范围广泛且严格执行，但漏洞也常有。伊朗依然能够每天出口几十万桶石油。其中大部分以马来西亚、阿曼或阿联酋石油的名义运往中国。违反制裁是危险的。但一些私营炼油商愿意冒这种风险，以换取大幅的价格折扣。而美元也并不是唯一的硬通货：人民币当然可以用，不过还有与美元挂钩的阿联酋迪拉姆。

其次，经济韧性源于出口的多元化。伊朗拥有一系列制造产业。一些较大的行业受益于廉价可靠的能源供应，如采矿和金属加工制造。此外，伊朗与几个人口众多的国家接壤，包括巴基斯坦和土耳其。伊朗的许多陆上贸易都没有单据凭证，因此难以监督。

第三个因素是进口替代。里亚尔贬值让许多伊朗人买不起进口商品。但对制造商来说，服务有8300万人口的国内市场反而成了福音。一名当地人说，在德黑兰购物时你会看到伊朗制造的服装、玩具和家居用品。他说，“如果有一个全球自给自足指数，伊朗的排名会很高。”

伊朗的股市反映了其经济韧性。一些大公司被列入制裁名单，但成百上千的小公司得以幸免。事实证明，股票是对冲货币贬值和通货膨胀的利器。许多本地人已经注意到这一点。随着散户投资者蜂拥而至，伊朗股市在2020年暴涨。这个小型泡沫后来破灭了。投资伊朗的基金Amtelon Capital的马西耶·沃伊塔（Maciej Wojtal）说，现在股票又便宜了。根据伊朗分析师的预测，伊朗百强企业的市盈率中值在五倍左右。

伊朗领导人一直标榜自己的“抵抗经济”。但这种经济坚韧主要反映了一种自下而上的基本生存斗争，而不是自上而下的战略选择，智库Bourse & Bazaar的埃斯凡迪亚尔·巴特曼赫利迪（Esfandiyar Batmanghelidj）最近撰文指出。经济体是由普罗大众构成的。他们会竭尽所能适应环境的变化。对伊朗人民来说，未来的日子可能真得会变得更好。而对于俄罗斯人民来说，痛苦的调整才刚刚开始。■



When China met the free market

A nickel-trading fiasco raises three big questions

London's freewheeling metals exchange is under scrutiny

THE TRADING of commodities is an arcane activity that makes it into the public eye only at times of extreme hubris. That is when names like the Hunt brothers, who tried to corner the silver market in 1980, and Hamanaka Yasuo, or “Mr Copper”, who in 1996 produced huge losses for Sumitomo, a Japanese trading house, became household ones. Xiang Guangda, a Chinese tycoon known as “Big Shot”, vaulted into the news this month by taking a position on nickel that went badly wrong. The result has been one of the biggest tremors in the 145-year history of the London Metal Exchange (LME). It has also brought China, which is keen to exert more power over the trading of commodities, face to face with free markets gone mad.

In the cloistered world of the LME, some facts about the affair are clear. One is that nickel prices, already hot before Russia's invasion of Ukraine, surged after the West imposed sanctions on Russia. Another is that Mr Xiang's firm, Tsingshan, had exposure to short positions on the LME of about 180,000 tonnes of nickel, which were supposed to benefit if prices went down. They didn't, as a short-covering scramble for nickel briefly pushed prices above \$100,000 a tonne on March 8th, putting Tsingshan's potential losses into the billions of dollars. At that point the LME suspended nickel trading, cancelling all trades that took place overnight. When the suspension was lifted on March 16th, a sharp drop in nickel prices forced the LME to suspend trading again, adding to the chaos.

Three big questions remain. How important is Tsingshan's role in the debacle? Did its troubles provoke interference from China? And has the LME bungled its response? All will be the subject of scrutiny.

In media reports, Tsingshan has the lead role in the drama. There is debate about whether its short-selling represented the normal activity of one of the world's largest nickel producers hedging its output, or a speculator making a rash bet. What appears clear is that the nickel it produces is not the type of metallic nickel that is traded on the LME, meaning there was a mismatch between its shorts and longs. As its losses increased, its brokers forced it to provide more cash, or "margin". The size of its position meant that they also faced big margin calls, making it as much their problem as Tsingshan's. On March 15th Tsingshan said it had reached a standstill agreement with its creditors until it reduces its positions in an orderly way.

In the market, rumours abound that China may have influenced the LME's activities, partly because Hong Kong Exchanges and Clearing (HKEX) owns the exchange, and also because Tsingshan is strategically important to the country, because its nickel goes into electric-vehicle batteries. The LME denies receiving pressure from HKEX. It granted extra time on March 7th to CCBI Global, a Chinese broker for Tsingshan that is a member of the LME, to raise funds from its state-owned parent, China Construction Bank, to cover margin calls. That may have been a prudent thing to do. It knew the wealthy bank could provide the funds. Some traders wonder whether it would have been as tolerant with a non-Chinese entity. In the aftermath, Chinese authorities are said to have fought hard to stop Tsingshan's nickel assets falling into the hands of non-Chinese speculators.

The most intense scrutiny may fall on the LME itself, specifically the timing of its decision to suspend nickel trading and the cancelling of overnight trades that were rumoured to be in the billions of dollars. It said it halted trading in the early hours of March 8th when it reckoned the nickel market had become disorderly. It added that its decision to cancel that day's trades was because the big price moves had created a systemic risk to the market, raising concerns of multiple defaults by member-brokers struggling to meet margin calls.

That latter decision is the biggest bone of contention. Critics say it favoured those with short positions, such as physical producers and their banks, over those with long positions that could be sold at a big profit. They ask why it stepped in to protect brokers when the LME has a default fund that its members can get access to in times of trouble. “The decision to erase the trades...will undermine long-term confidence in the LME,” says Yao Hua Ooi of AQR, an asset manager that had trades cancelled on March 8th. “If you want the AQRs of this world [in the market], you cannot intervene when they make money and it hurts your brokers.” He said the firm was exploring all options against the LME.

The LME has since set daily limits on price moves (which were exceeded on March 16th when it briefly reopened nickel trading). That is another sign of intervention by an exchange that used to pride itself on its free-market nature. Its owner in Hong Kong, with China looking over its shoulder, would no doubt approve. ■



当中国遭遇自由市场

一场镍交易闹剧带出三大问题

伦敦不受管束的金属交易所如今备受审视

大宗商品交易是一种复杂难懂的活动，唯有在极度狂妄之举发生时才会走进大众视野。在这些时候，一些名字变得家喻户晓，比如在1980年试图操纵白银市场的亨特兄弟，还有在1996年让日本贸易商住友商事大亏特亏的“铜先生”滨中泰男。本月登上新闻头条的是中国“大佬”项光达，因为他的镍持仓出了大岔子。结果引发了伦敦金属交易所（以下简称LME）成立145年以来最大的震荡之一。这也让渴望在大宗商品交易上施加更多影响力的中国正面遭遇了陷入疯狂状态的自由市场。

在LME这个隐秘的圈子里，这起事件的一部分事实是清晰的。其一是镍价在俄罗斯入侵乌克兰之前就已经过热，在西方对俄罗斯实施制裁之后更是进一步飙升。另一是项光达的青山控股集团在LME持有约18万吨镍空头头寸，以求在镍价下跌时获利。但镍价没有下跌，3月8日，大量空头争相回补，镍价一度被推高至超过每吨10万美元，被逼仓的青山可能要损失数十亿美元。那一刻，LME宣布暂停镍交易并取消当地时间当天零点起的所有镍交易。3月16日LME重开镍市，但镍价急跌迫使LME再次暂停交易，混乱进一步加剧。

还有三个待解答的大问题。在这次崩盘中，青山扮演了多重要的角色？它面对的麻烦是否促使中国政府出手干预？LME的应对是否有误？所有这些都将被备受审视。

在媒体报道中，青山是这出闹剧的主角。各方争论它做空镍价究竟是身为全球最大镍生产商之一对冲自家产出的正常操作，还是一个投机分子的鲁莽押注。有一点很清楚，它生产的镍并非在LME交易的那种金属镍，也就是说它的空头和多头是不匹配的。随着它的浮亏上升，经纪商迫使其追加保证金。它的头寸规模意味着这些经纪商也将被追缴大笔保证金，它的麻烦也成了经纪商的麻烦。3月15日，青山表示已与债权人达成一项静默协

议，期间它将合理有序地减少现有持仓。

市场上盛传中国政府可能对LME的应对施加了影响，部分原因是LME隶属香港交易所集团，此外青山对中国具有战略意义，因为它生产的镍用于电动汽车电池。LME否认受到来自港交所的压力。3月7日，LME给了建银国际（CCBI Global，青山控股的中国经纪商，其英国子公司是LME的会员公司）额外的时间，让它从国有母公司中国建设银行筹钱缴纳追加的保证金。这也许是审慎之举。LME知道资金雄厚的建行能够提供资金。一些交易员则质疑假如涉事的不是中国公司，LME是否也会同样地宽容。事发后，据说中国政府竭力阻止青山的镍资产落入非中国投机者手中。

最严格的审视可能会落在LME身上，特别是它决定暂停镍交易和取消隔夜交易（传闻价值数十亿美元）的时间点。LME表示，它在3月8日清晨认为镍市场已失序，所以暂停了交易。它进而解释说，决定取消当天已完成的交易是因为镍价的大幅波动已经给市场带来了系统性风险，让人担心LME的会员经纪商会难以支付追加保证金而纷纷违约。

取消交易的决定最受质疑。批评者说，此举有利于实体生产商及其银行等做空者，不利于那些可以通过卖出获取厚利的做多者。他们质问，既然LME已设立违约基金供会员救急之用，为什么这次还要插手保护经纪商。“取消交易的决定.....将破坏市场对LME的长期信心。”3月8日被取消交易的资产管理公司AQR的黄姚华（Yao Hua Ooi，音译）说，“如果你希望像AQR这样的公司（留在市场上），就不能在它们赚钱而你的经济商吃亏的时候干涉。”他表示AQR正在寻求各种途径向LME维权。

此后，LME对镍价每日涨跌幅度设定了限制（3月16日镍市短暂重开期间涨幅突破了限制）。这是一家曾以秉承自由市场精神为傲的交易所开始干预交易的另一迹象。有中国政府在背后紧张地盯着，其香港母公司无疑会支持这么做。■



Flight risk

Sanctions on Russian aviation are a burden for Western firms

And could prove devastating for Aeroflot and other Russian airlines

AS VLADIMIR PUTIN'S troops continued to lay waste to Ukraine on March 5th, Russia's president surrounded himself with bouquet-wielding young women training as cabin crew for Aeroflot, the state-controlled airline. Aviation is vital for connecting the vast country. The uneasy grins on the faces of the ladies to whom he explained that Western sanctions were an act of war hinted that they understood the implications for their long-term career prospects. The same day that Mr Putin met its trainees, Aeroflot suspended all its international flights. By then the carrier had few places to fly. Britain was the first to ban Russian planes in reaction to the invasion of Ukraine. They are now also barred from skies above America, Canada, the EU and several other places. Western carriers, meanwhile, are no longer welcome in Russia airspace.

| *Anti-aircraft warfare*

The direct impact on non-Russian airlines is "no big deal", says Keith McMullan of Aviation Strategy, a consultancy. Flights to Mr Putin's realm are a sliver of business for the world's large airline groups. The closure of Russian airspace is an inconvenience for European ones serving north-east Asia, which will have to divert flights to more southerly routes, adding up to two hours to flying time to Beijing. But with China still in lockdown such flights are not as numerous as before. It is the knock-on effects of Russia's invasion that investors in the global airline-industrial complex worry about. Rather than continue their rebound as covid clouds clear, airlines, airport operators, travel websites, planemakers, other suppliers and aircraft lessors have lost nearly \$120bn in combined market value so far this year (see chart).

The most immediate problem is the surge in oil prices. The cost of crude, already near a 14-year high, surged again on March 8th after America announced a ban on imports from Russia, the world's third-biggest producer. IATA, an industry body, forecast in October that airlines' fuel bill in 2022 would hit \$132bn, accounting for nearly 20% of operating expenses, with a barrel of Brent at \$67. It now costs nearly twice as much. Airline shares have lost around 15% of their value in the past two weeks. Those carriers that do not hedge fuel costs were hit hardest; some have already added surcharges on tickets.

Other Western measures will also take a toll. America and the EU have targeted Russian aviation by banning the sale or purchase of planes and parts, financing and technical assistance. Britain joined in on March 9th. Russia is not a huge market for the world's planemaking duopoly of Airbus and Boeing. Only 62 jets out of the their combined order book of 12,000 are destined for the country. But even a relatively small knock is unwelcome as the industry tries to lift itself up after two years of covid-19 upheaval.

Moreover, the planemakers may, like other Western businesses, feel the need to distance themselves from Russia in other ways. Boeing has already ended a contract to acquire Russian titanium for its planes; finding alternative supplies may be a problem given that Russia is the metal's third-biggest producer. Russia's big role in other commodities markets, from nickel to palladium, may also ripple through aero space supply chains.

Another collateral victim of Russia's aggression, and the West's response to it, is the aircraft-leasing industry. Around half of Russia's fleet is owned by non-Russian lessors. Those 500 or so planes are valued at some \$10bn, according to IBA, a consultancy. To comply with Western sanctions, such leases must be terminated by March 28th. After that, in theory, Russian airlines must return the jets to their owners. Repossession is, however, made considerably harder by the closure of Russian airspace and the

difficulty of getting the repo men into Russia. The fact that no planes are leaving the country hints at a possibility of expropriation.

As with planemakers, the lessors' business with Russia is not huge. AerCap, the world's biggest such firm with the highest exposure to Russia, leases 5% of its fleet by value to Russian carriers. And although Mr Putin may force state-run Aeroflot to deny Western lessors their planes, private carriers may prefer to hand theirs back, lest they be frozen out of aircraft financing for years after the crisis abates. In any case, leasing firms insist they are insured against this type of loss. Investors are not so sure. AerCap's share price dropped by nearly a third in the week after the sanctions were announced (though they have rebounded a bit since).

All these problems, though real, pale in comparison with the woes of Russia's airlines. Its vast domestic market, accounting for 4.5% of global demand, was one of the most resilient throughout the pandemic. Last year it exceeded pre-covid levels. Now Russian carriers are flying on borrowed time. Even if the lessors do not reclaim their aircraft, other sanctions prevent Western firms from providing parts or technical support. Two-thirds of planes in Russia come from Airbus and Boeing. The Sukhoi Superjet, a Russian-made regional jet, has a Western engine and avionics. Cannibalising, engineering or acquiring uncertified spares from dodgy third parties may work for a while but is unsustainable in the longer run.

Regular maintenance to accepted international standards may soon become impossible, too. So will insuring Russian planes, most of which are covered through Lloyd's of London, a marketplace for brokers and underwriters. Even booking and payment systems, mostly outsourced to Western technology firms, may no longer function. It is back to "spreadsheets and pencils", says Andrew Charlton of Aviation Advocacy, another consultancy. In just a few months Russian airlines could grind to a halt, says Mr McMullan. Before then passengers may have to board planes

that have missed maintenance, are fitted with suspect spares and are uninsured. Many may opt for the train instead. ■



飞行风险

对俄罗斯航空业的制裁也让西方公司承压

对俄航和其他俄罗斯航空公司可能是毁灭性打击

三月五日，当普京的军队继续践踏乌克兰时，这位俄罗斯总统的身边围绕着一群手捧花束的年轻姑娘，她们正在接受国有航空公司俄罗斯航空（Aeroflot）的乘务员培训。航空业对于连接这个幅员辽阔的国家至关重要。他向这些女士们解释说，西方的制裁是战争行为，而她们脸上挤出的笑容透露出她们明白这对于自己的长期职业前景意味着什么。就在普京会见这些培训生的同一天，俄罗斯航空暂停了所有的国际航班。其时，这家航空公司已经没有多少目的地可飞了。作为对入侵乌克兰的回应，英国第一个禁止了俄罗斯飞机进入其领空。如今，它们也被禁止进入美国、加拿大、欧盟以及其他几个地方的领空。与此同时，西方的航空公司也不再被允许进入俄罗斯领空。

| 防空战

这对非俄罗斯的航空公司造成的直接影响“无足轻重”，咨询公司Aviation Strategy的基思·麦克马伦（Keith McMullan）表示。对于全球大型航空集团来说，飞往普京领地的航班只占很小一部分业务。俄罗斯领空的关闭给那些飞东北亚的欧洲航空公司带来了不便，它们将不得不让航班绕道偏南的航线，这样到北京的飞行时间最多会增加两个小时。不过由于中国仍处于疫情封锁状态，这类航班也不像以前那么多。让全球航空产业群的投资者担心的是俄罗斯入侵带来的连锁反应。随着新冠疫情的阴云消散，它们本应继续复苏之路，但今年截至目前，航空公司、机场运营商、旅游网站、飞机制造商、其他供应商以及飞机租赁公司的市值加起来已经损失了近1200亿美元（见图表）。

最直接的问题是油价飙升。在美国宣布禁止从世界第三大产油国俄罗斯进口原油后，3月8日，已经接近14年来最高点的原油价格再次飙升。去年10月，行业组织国际航空运输协会（IATA）预测2022年航空公司的燃油账

单将高达1320亿美元，占运营费用的近20%——当时布伦特原油价格为每桶67美元，而现在几乎翻了一番。在过去的两周里，航空公司股价已经缩水了大约15%。那些没有对燃油成本进行对冲的航空公司受到的打击最大，一些公司已经在对机票征收附加费。

西方的其他措施也会造成损失。美国和欧盟已经禁止向俄罗斯航空业出售或购买飞机和零部件、提供资金和技术援助。英国于3月9日跟进。对于空客和波音这两家全球飞机制造寡头来说，俄罗斯并不是个巨大的市场。在两家公司总计1.2万架喷气式飞机的订单中，俄罗斯只有62架。但即便是相对较小的冲击也不受欢迎，因为飞机制造业在经历了两年新冠肺炎的折腾后，正力图振作起来。

此外，飞机制造商可能会像其他西方企业一样，觉得有必要在其他方面与俄罗斯保持距离。波音已经终止了从俄罗斯购买飞机用钛的合同，而鉴于俄罗斯是全球第三大钛生产国，找到替代供应方可能是个问题。俄罗斯在镍、钯等很多其他大宗商品市场上的重要地位可能也会波及到航空航天业的供应链。

俄罗斯的侵略行径以及西方的反应的另一个附带受害者是飞机租赁业。俄罗斯约一半的飞机由外国租赁公司拥有。根据咨询公司IBA的数据，这500架左右的飞机价值约100亿美元。为了遵守西方的制裁，这类租约必须在3月28日前终止。理论上说，在那之后，俄罗斯的航空公司必须将飞机归还给所有者。然而，由于俄罗斯领空关闭，以及追讨人员难以进入俄罗斯，收回飞机的难度大大增加。飞机无法离开俄罗斯意味着它们有可能被没收。

和飞机制造商一样，租赁公司在俄罗斯的业务也不是非常大。全球最大的航空租赁公司AerCap对俄罗斯的敞口最大，它租给俄罗斯各航空公司的飞机占到自己飞机总价值的5%。尽管普京可能会强迫国有的俄罗斯航空拒绝归还西方租赁公司的飞机，但私有航空公司可能更愿意归还飞机，以免在此次危机缓解后的多年里自己都被排斥在飞机融资领域之外。不管怎样，各家租赁公司都坚称自己对这类损失投了保险。但投资者没那么放

心。在制裁宣布后的一周内，AerCap的股价跌去了近三分之一（不过此后略有反弹）。

所有这些问题确实存在，但与俄罗斯各家航空公司的困境比起来，就是小巫见大巫了。俄罗斯巨大的国内航空市场占到全球需求的4.5%，是整个新冠疫情期间韧性最强的市场之一。去年它超过了疫情前水平。现在，俄罗斯的航空公司已经在苟延残喘。即使租赁公司不收回飞机，其他制裁措施也会阻止西方公司为它们提供零部件或技术支持。俄罗斯三分之二的飞机来自空客和波音。俄罗斯自己制造的支线飞机苏霍伊超级喷气机（Sukhoi Superjet）采用的是西方发动机和航空电子设备。拆用、改造或购买来自不可靠第三方的未认证配件或许能勉强应付一阵子，但不可持续。

要按公认的国际标准继续定期维护可能很快也做不到了。给俄罗斯的飞机上保险也是如此，它们大多是通过伦敦的经纪人和保险商市场劳合社（Lloyd's）投保的。就连预订和支付系统（主要外包给西方科技公司）也可能无法运作了。这又回到了“纸质账本和铅笔”的时代，另一家咨询公司Aviation Advocacy的安德鲁·查尔顿（Andrew Charlton）表示。俄罗斯的航空公司可能会在短短几个月内渐渐停摆，麦克马伦说。而在那之前，乘客可能不得不登上那些没有按期维护、装着不靠谱配件以及没上保险的飞机。许多人可能会改坐火车。 ■



Robotics

Covid has reset relations between people and robots

Machines will do the nasty jobs; human beings the nice ones

ROBOTS HAVE been around for six decades or so. Originally, they were simple devices which did as they were told, working on assembly lines in, well, a robotic manner. They were often kept in cages, like zoo animals, to stop people getting too close. And for similar reasons. They were dangerous. If a mere human being got in the way of a swinging robotic arm, so much the worse for the human.

Since then, they have got vastly more dexterous, mobile and autonomous. They are also more collaborative. There are now over 3m robots working in factories across the planet, according to the International Federation of Robotics, a worldwide industry association. Millions more move goods around warehouses, clean homes, mow lawns and help surgeons conduct operations. Some have also begun delivering goods, both on land and by air.

The pace of automation is likely to accelerate, for two reasons, a panel of robotics experts told the 2022 meeting of the American Association for the Advancement of Science (AAAS), held for the second year running in cyberspace, rather than in Philadelphia, as originally planned. The first reason is that covid-19 has created social changes which look likely to endure. The “Great Resignation”, in which millions around the world have quit their jobs, may in part be a consequence of lockdowns creating new opportunities for home working. These so-called lifestyle choices about which jobs to do, together with creaking supply chains and a boom in e-commerce, have left warehouses and many other businesses struggling to recruit workers.

| *Universal robots*

The second reason is that the bots are getting better. Instead of just moving goods in warehouses to human “pickers”, who then put items into bags for home delivery, they are learning to do the picking and packing for themselves. In factories, they are stepping out of their cages and, equipped with advanced sensors and machine learning, a form of artificial intelligence (AI), are going to work alongside people. Such robots will increasingly help out in other places too, including hospitals, and in roles, such as caring for an ageing society—which, post-covid, has got used to a more techno future for health care, with “telemedicine” via remote doctors and health-monitoring mobile-phone apps.

There is, though, a long way to go. In the field of manufacturing, car plants lead automation. But, as Henrik Christensen, director of the Contextual Robotics Institute at the University of California, San Diego, told the meeting, even the most advanced of them, those in South Korea, average only around one robot per ten workers. So-called “lights-out” car manufacturing, with no human beings on the factory floor, remains a distant dream.

Even so, the rise of robots makes some people fear for their jobs and ask how they will earn a living. “It’s a good question. I get it every week,” says Dr Christensen. He replies that jobs which robots undertake are usually dull, repetitive and strenuous—and, post-covid, such jobs are getting harder to fill. In many industries it is less a desire to reduce labour costs that is driving automation than the sheer difficulty of recruiting flesh-and-blood workers. Indeed, instead of destroying jobs, robots can create them by making businesses more efficient, allowing firms to expand. As Dr Christensen points out, for the past decade manufacturing employment in America has grown, even as the number of factory robots increased (see chart).

There is a similar fear in health care that robots will destroy jobs. But this is a myth, Michelle Johnson told the meeting. Dr Johnson is the director of the Rehabilitation Robotics Lab at the University of Pennsylvania, and currently works in Botswana on ways to use robots to help people recover from illness and injury. Even in America, let alone Africa, “there are just not enough clinicians to do the job,” she adds.

Dr Johnson has a particular interest in helping people recover from strokes. This sometimes requires intensive therapy for long periods. But public health-care systems are often too stretched to offer anything but limited treatment. Robots can help here, and in some circumstances may be better, even, than human physiotherapists, since they are both tireless and reliable. They can exercise a person’s limbs with consistent movements and take objective measurements of recovery. This, says Dr Johnson, allows a single occupational therapist, assisted by a technician, to look after, at the same time, half-a-dozen or so patients who would otherwise need one-to-one attention.

Robots that work with people in such ways do, though, require special training. And there is a long way to go to improve that, says Julie Shah, who leads the Interactive Robotics Group at the Massachusetts Institute of Technology. Most robots perform narrowly defined tasks, with mobile ones using their sensors to avoid bumping into people. “Robots need to see us as more than just an obstacle to manoeuvre around,” adds Dr Shah. “They need to work with us and anticipate what we need.”

Studying what happens in factories shows that the most successful applications employ robots programmed by an engineer who is working side-by-side with someone (a so-called “domain expert”) fully versed in the tasks at hand. To make that easier, she and her colleagues are developing AI systems which can school a robot using natural-language commands.

Although all three experts believe robots will enhance human capability, one problem is that regulation lags technology. With covid-19, says Dr Johnson, some clinicians worried that even the spread of telemedicine might affect their indemnity insurance, let alone robots. And although a long road remains ahead for the development of autonomous delivery vans and lorries, Dr Christensen finds it “ludicrous” that a test vehicle driving across a state border in America may thereafter have to comply with a completely different set of regulations from those which pertained in the place whence it came. It seems an awful lot of meetings lie ahead for roboticists and regulators to determine how machines and people will work together. ■



机器人科学

新冠疫情重置了人与机器人的关系

脏活累活让机器去干，好工作留给人

机器人问世已有差不多60年了。最初，它们只是按指令行动的简单设备，在装配线上以“机器人般的风格”工作。它们常被关在笼子里——就像动物园里的动物——以免它们和人靠得太近。这么做的原因也跟动物园差不多：它们很危险。如果一个凡胎肉身挡住了一只挥舞的机械臂，那么更倒霉的还是人。

后来，机器人变得灵巧、机动和自主多了。它们也变得更会合作。根据世界性行业协会国际机器人联合会（International Federation of Robotics）的数据，全球现在有超过300万台机器人在工厂工作。还有数百万台机器人在仓库搬运货物、打扫房屋、修剪草坪、协助外科医生做手术。有些机器人还开始运输货物，有陆运也有空运。

在美国科学促进会（AAAS）2022年年会（原计划在费城举行，后改为线上会议，是该协会第二次线上年会）上，一个机器人专家小组表示，自动化的步伐可能会加快，有两点原因。首先是新冠疫情造成的社会变化看来会持续下去。全球掀起了成百上千万人辞掉原工作的“大辞职潮”，一定程度上可能是因为疫情封锁措施创造了新的居家工作机会。这种和干什么工作有关的所谓生活方式选择，加上供应链崩裂和电子商务繁荣，让仓库和许多其他企业都很难招到员工。

| 万能机器人

第二个原因是机器人越来越优秀了。以前它们只会把仓库里的货物交给人类“分拣工”，再由分拣工把货物打包以便送货上门，现在它们学会了自己分拣并打包。在工厂里，它们正在走出笼子，配备上先进的传感器和机器学习（一种人工智能），要与人一同作业。这样的机器人也将在医院等其他场所帮上更多忙，在某些角色上发挥日益重要的作用，比如照顾一个老龄化的社会——这样的社会在疫情后已经接受了一个更科技化的医疗未

来，通过网上问诊和手机中的健康监测应用实现“远程医疗”。

不过，前路依然漫长。在制造业领域，引领自动化的是汽车工厂。但是，加州大学圣地亚哥分校情境机器人技术研究所（Contextual Robotics Institute）所长亨里克·克里斯滕森（Henrik Christensen）在年会上表示，即使是最先进的韩国的汽车工厂，大概也就是平均每十个工人配备一个机器人。那种车间里再没有工人身影的所谓“熄灯式”汽车制造仍然是个遥远的梦想。

即便如此，机器人的兴盛仍让一些人担心自己工作不保，发问未来要如何谋生。“这是个好问题。我每周都会被问到。”克里斯滕森说。他的回答是，机器人承担的工作通常是枯燥、重复和艰苦的，而且在新冠疫情后，这类工作越来越难招到人。在许多行业，推动自动化首先不是为了降低劳动力成本，而是因为要招到有血有肉的工人实在太难了。事实上，机器人并不是在破坏就业机会，而是能通过提高效率让公司得以扩张，从而创造就业机会。正如克里斯滕森指出的，过去十年，在工厂机器人的数量增长的同时，美国制造业的就业人数也在增长（见图表）。

在医疗保健领域，人们也有类似的担忧，担心机器人会摧毁工作岗位。但米歇尔·约翰逊（Michelle Johnson）在会上表示，这是一种普遍的误解。约翰逊是宾夕法尼亚大学康复机器人实验室（Rehabilitation Robotics Lab）的主任，目前正在博茨瓦纳研究如何利用机器人帮助人们从伤病中康复。且不说非洲，即便在美国，“也没有足够的临床医生来做这项工作。”她补充道。

约翰逊对帮助中风患者康复尤其感兴趣。这有时需要长周期的强化治疗。但公共卫生体系往往忙不过来，只能提供有限的医治。机器人可以在这方面提供帮助，在某些情况下甚至可能比人类理疗师做得更好，因为它们不知疲倦又很可靠。它们可以用始终如一的动作锻炼人的四肢，并客观评价恢复情况。约翰逊说，有了它们，一名职业治疗师可以在一名技术人员的协助下同时照看五六个原本需要一对一照护的病人。

不过，以这种方式与人合作的机器人需要经过特殊训练。麻省理工学院互动机器人小组（Interactive Robotics Group）的负责人朱莉·沙阿（Julie Shah）表示，在这方面还需要大幅提升。大多数机器人执行的是非常明确具体的任务，其中四下移动的机器人通过配备的传感器来避免撞到人。“机器人不能只把我们看作是它移动过程中需要避开的障碍物，”沙阿补充说，“它们要能和我们一起工作，预测我们需要什么。”

对工厂进展的研究表明，在最成功的应用中，为机器人编程的工程师是和某个完全精通所经手的工作的人（也就是所谓的“领域专家”）并肩工作的。为了让利用机器人的过程变得更简单，她和她的同事正在开发可以使用自然语言指令训练机器人的人工智能系统。

尽管三位专家都认为机器人将提高人类的能力，但有一个问题是监管总是滞后于技术。约翰逊说，在新冠肺炎上，一些临床医生担心即使是远程医疗的广泛使用也可能会影响他们能拿到多少损失补偿性保险，更不用说机器人了。虽然自动送货的厢式货车和卡车的发展仍然前路漫漫，但让克里斯腾森觉得“荒唐可笑”的是，一辆测试车穿越美国一个州界后，可能就得遵守一套跟出发地完全不同的法规。看起来，机器人专家和监管官员还要开很多很多的会来确定机器人和人类将如何合作。■



The bots in the warehouse

New robots—smarter and faster—are taking over warehouses

Most picking jobs will be done by bots

A DECADE AGO Amazon started to introduce robots into its “fulfilment centres”, as online retailers call their giant distribution warehouses. Instead of having people wandering up and down rows of shelves picking goods to complete orders, the machines would lift and then carry the shelves to the pickers. That saved time and money. Amazon’s sites now have more than 350,000 robots of various sorts deployed worldwide. But even that is not enough to secure its future.

Advances in warehouse robotics, coupled with increasing labour costs and difficulty in finding workers, have created a watershed moment in the logistics industry. With covid-19 lockdowns causing supply-chain disruptions and a boom in home deliveries that is likely to endure, fulfilment centres have been working at full tilt.

Despite the robots, many firms have to bring in temporary workers to cope with increased demand during busy periods. Competition for staff is fierce. In the run-up to the holiday shopping season in December, Amazon brought in some 150,000 extra workers in America alone, offering sign-on bonuses of up to \$3,000.

The long-term implications of such a high reliance on increasingly hard-to-find labour in distribution is clear, according to a new study by McKinsey, a consultancy: “Automation in warehousing is no longer just nice to have but an imperative for sustainable growth.”

This means more robots are needed, including newer, more efficient versions to replace those already at work and advanced machines to take

over most of the remaining jobs done by humans. As a result, McKinsey forecasts the warehouse-automation market will grow at a compound annual rate of 23% to be worth more than \$50bn by 2030.

The new robots are coming. One of them is the prototype 600 Series bot. This machine “changes everything” according to Tim Steiner, chief executive of Ocado Group, which began in 2002 as an online British grocer and has evolved over the years into one of the leading providers of warehouse robotics.

The 600 Series is a strange-looking beast, much like a box on wheels made out of skeletal parts. That is because more than half its components are 3D-printed. As 3D-printing builds things up layer by layer it allows the shapes to be optimised, thus using the least amount of material. As a result, the 600 Series is five times lighter than the company’s present generation of bots, which makes it more agile and less demanding on battery power.

| *March of the machines*

Ocado’s bots work in what is known as the “Hive”, a giant metallic grid at the centre of its fulfilment centres. Some of these Hives are bigger than a football pitch.

Each cell on the grid contains products stored in plastic crates, stacked 21 deep. As orders arrive, a bot is dispatched to extract a crate and transport it to a picking station, where a human worker takes all the items they need, scans each one and puts them into a bag, much as happens at a supermarket checkout.

It could take an hour or so walking around a warehouse to collect each item manually for a large order. But as hundreds of bots operate on the grid simultaneously, they are much faster. The bots are choreographed by an artificially intelligent computer system, which communicates with each

machine over a wireless network. The system allows Ocado's current bot, the 500 Series, to gather all the goods required for a 50-item order in less than five minutes.

The new 600 Series will match or better its predecessor's performance and use less energy. It also "unlocks a cascade of benefits", says Mr Steiner, allowing Hives to be smaller and lighter. This means they can be installed in weeks rather than months and at a lower cost. That will make "micro" fulfilment centres viable. Most fulfilment centres are housed in large buildings on out-of-town trading estates, but smaller units could be sited in urban areas closer to customers. This would speed up deliveries, in some cases to within hours.

Amazon is also developing more-efficient robots. Its original machines were known as Kivas, after Kiva Systems, the Massachusetts-based firm that manufactured them. The Kiva is a squat device which can slip under a stack of head-height shelves in which goods are stored. The robot then lifts and carries the shelves to a picking station. In 2012 Amazon bought Kiva Systems for \$775m and later changed its name to Amazon Robotics.

| *Welcome to the jungle*

Amazon Robotics has since developed a family of bots, including a smaller version of a Kiva called Pegasus. These will allow it to pack more goods into its fulfilment centres and also use bots in smaller inner-city distribution sites. To prepare for a more automated future, Amazon Robotics recently opened a new robot manufacturing plant in Westborough, Massachusetts, to boost its output.

In 2014, when it became clear that future Kivas would be made exclusively for Amazon, Romain Moulin and Renaud Heitz, a pair of engineers working for a medical firm, decided to set up Exotec, a French rival, to produce a different sort of robotic warehouse. The firm has developed a three-

dimensional system, which uses bots called Skypods. Looking a bit like Kivas, they also roam the warehouse floor. But instead of moving shelves, Skypods climb them. Once the robot reaches the necessary level, it extracts a crate, climbs down and delivers it to a picking station.

Skypods, says Mr Moulin, maximise the space in a warehouse because they can ascend shelving stacked 12 metres high. Being modular, the system can be expanded easily. As well as returning crates to the shelves, Skypods also take them to places to be refilled.

A number of retailers have started using Skypods, including Carrefour, a giant French supermarket group, GAP, an American clothing firm, and Uniqlo, a Japanese one. Because such robots move quickly and could cause injury—Skypods zoom along at four metres per second (14kph)—they tend to operate in closed areas. If Amazon's staff need to enter the robot area they don a special safety vest. This contains electronics which signal to any nearby bots that a human is present. The bot will then stop or take an alternative route.

Some robots, however, are designed to work alongside people in warehouses. They often ferry things between people taking goods off shelves and pallets to people putting them into bags and boxes for shipping. Such systems can avoid the cost of installing fixed infrastructure, which lets warehouses be reconfigured quickly—useful for logistics centres that work for multiple retailers and have to deal with constantly changing product lines.

When robots work among people, however, they have to be fitted with additional safety systems, such as cameras, radar and other sensors, to avoid bumping into staff. Hence they tend to move slowly and are cautious, which can result in bots frequently coming to a standstill and slowing operations. However, machines that are more capable and aware of their

surroundings are on the way.

For instance, NEC, a Japanese electronics group, has started using “risk-sensitive stochastic control technology”, which is software similar to that used in finance to avoid high-risk investments. In this case, though, it allows a robot to weigh up risks when taking any action, such as selecting the safest and fastest route through a warehouse. In trials, NEC says it doubles the average speed of a robot without making compromises on safety.

| *New tricks*

The toughest job to automate in a warehouse is picking and packing, hence the demand for extra pairs of hands during busy periods. This task is far from easy for robots because fulfilment centres stock tens of thousands of different items, in many shapes, sizes and weights.

Nevertheless, Amazon, Ocado, Exotec and others are beginning to automate the task by placing robotic arms at some picking stations. These arms tend to use cameras and read barcodes to identify goods, and suction pads and other mechanisms to pick them up. Machine learning, a form of AI, is employed to teach the robots how to handle specific items, for example not to put potatoes on top of eggs.

Ocado is also developing an arm which could bypass a picking station and take items directly from crates in the Hive. Fetch Robotics, a Silicon Valley producer of logistics robots that was acquired last year by Zebra Technologies, a computing firm, has developed a mobile picking arm which can travel around a fulfilment centre.

Boston Dynamics, another Massachusetts robot-maker, has come up with a heavyweight mobile version called Stretch, which can unpack lorries and put boxes on pallets. On January 26th DHL, a logistics giant, placed the first

order for Stretch robots. It will deploy them in its North American warehouses over the next three years.

That timetable gives a clue that progress will not be rapid. It will take ten to 15 years before robots begin to be adept at picking and packing goods, reckons Zehao Li, the author of a new report on warehouse robotics for IDTechEx, a firm of British analysts. Some companies think their bots will be able to pick 80% or so of their stock over the coming years, although much depends on the range of goods carried by different operations.

Objects with irregular shapes, like bananas or loose vegetables, can be hard for a robot to grasp if it has primarily been built to pick up products in neat packages. The bot might also be restricted in what weight it can lift, so would struggle with a flat-screen television or a heavy cask of beer. Further into the future, systems could emerge to overcome many of these limitations, such as multi-arm robots.

So what jobs will remain? On the warehouse floor, at least, that mainly leaves technicians maintaining and fixing robots, says Mr Li. He thinks there are also likely to be a handful of supervisors watching over the bots and lending a hand if there remains anything that their mechanical brethren still can't handle. It is not just inside the warehouse where jobs will go, but outside, too, once driverless delivery vehicles are allowed. At that point many products will travel through the supply chain and to people's homes untouched by human hand.

People will also be employed building robots. Amazon Robotics's new factory will create more than 200 new manufacturing jobs, although that dwindles into insignificance compared with the more than 1m jobs which the pioneer of e-commerce has created since the first robots arrived in its fulfilment centres. A lot of those jobs are bound to go, although many are monotonous and strenuous, which is why they are hard to fill.

However, other jobs will emerge. Technological change inevitably creates new roles for people. In the 1960s there used to be thousands of telephone switchboard operators, a job which has almost disappeared since exchanges became automated. But the number of other jobs in telecoms has soared. As logistics gets more efficient through greater automation, and online businesses grow, the overall level of employment in e-commerce should still increase. Many of these roles will be different sorts of jobs, just as there are many different sorts of robot. ■



仓库里的机器人

更快更智能的新型机器人正在接管仓库

大多数拣货工作将由机器人完成【深度】

十年前，亚马逊开始在它名为“履单中心”的巨大配送仓库里启用机器人。不需要人类员工在一排排货架之间来回穿梭拣货，机器人会把货架举起来送到拣货员面前。这既省时又省钱。亚马逊如今在全球部署了超过35万台各种各样的机器人。但即便这样也不足以确保未来的需要。

仓储机器人技术的进步，加上劳动力成本增加和招工困难，已经在物流行业引发转折点。眼下疫情封锁导致供应链中断，而送货到家业务量大增的势头应该会持续下去，因此履单中心一直在开足马力运作。

尽管有机器人，许多公司在业务旺季还是需要聘用临时工来应对需求增长。招工的竞争十分激烈。在去年12月假日购物季前夕，亚马逊仅在美国就增加了约15万名员工，入职奖金高达3000美元。

咨询公司麦肯锡的一项新研究认为，高度依赖日益难求的劳动力对物流配送的长期影响显而易见：“仓储自动化不再只是锦上添花的东西，而是可持续发展的必要条件。”

这意味着需要更多机器人，包括用更新、更高效的版本替换已投入使用的机器人，以及用先进的机器人接替大部分现在仍由人类完成的工作。因此，麦肯锡预测仓储自动化市场将会以23%的复合年增长率扩张，到2030年市场规模将超过500亿美元。

新一代机器人即将进驻。其中之一是“600系列”机器人原型。这款机器人“改变了一切”，奥卡多集团（Ocado Group）的首席执行官蒂姆·斯坦纳（Tim Steiner）说。这家2002年成立的英国公司最初是一家在线杂货零售商，这些年来已变身为仓储机器人的主要供应商之一。

“600系列”外形奇特，很像一个由骨架式部件制成的带轮子的盒子。那是

因为它一半以上的部件都是3D打印的。由于3D打印是逐层构建成型，因此可以优化形状，把材料用量降到最低。“600系列”因而比奥卡多当前一代机器人轻五倍，所以它更灵活，对电池电量的要求也更低。

| 进击的机器

奥卡多的机器人在“蜂巢”里工作，这是履单中心里的一个巨大的网格状金属柜。有些“蜂巢”比足球场还大。

网格柜的每个单元格里都放着装有货品的塑料板条箱，堆叠了21层之多。收到订单后，一台机器人会被派去抽取一个板条箱并把它送到分拣站。在那里，一名人类员工拿出所需要的所有物品，逐个扫描并放入一个袋子中，就和在超市收银台的操作差不多。

如果是一张大订单，靠人员在仓库中四下取货可能需要一个小时左右。但如果是几百台机器人同时在网格柜上工作，速度就快得多了。这些机器人的工作路线由一个人工智能计算机系统安排，它通过无线网络与每台机器人通信。在这个系统的操控下，奥卡多当前的“500系列”机器人可以在五分钟之内取完一张有50件货品的订单。

新的600系列在性能上将等同或优于500系列，而能耗更少。斯坦纳说，它还会“释放一连串的好处”，让“蜂巢”更小更轻。这意味着它们可以在几周内安装完毕，而无需几个月，安装成本也更低。这将让“微型”履单中心变得可行。大多数履单中心都设在郊区贸易园区的大楼里，但较小的履单中心可以设在离客户更近的市区。这将加快配送速度，有时几小时内即可送达。

亚马逊也在开发更高效的机器人。它最早的机器人叫Kiva，以制造它们的马萨诸塞州的公司Kiva Systems命名。这种扁扁的机器人可以滑到存放货物的一人高的货架之下，然后举起货架，把它送到分拣站。2012年，亚马逊以7.75亿美元收购了Kiva Systems，后将其更名为亚马逊机器人公司（Amazon Robotics）。

| 欢迎来到丛林

此后，亚马逊机器人公司开发了一系列机器人，包括Kiva的缩小版Pegasus。这将让亚马逊能在履单中心存放更多商品，并在较小的市区配送站使用机器人。为了迎接更高度自动化的未来，该公司最近在马萨诸塞州的韦斯特伯勒（Westborough）开设了一家新的机器人制造厂以提高产量。

2014年，当明确了未来Kiva机器人将专为亚马逊生产后，一家医疗公司的两名工程师罗曼·莫林（Romain Moulin）和雷诺·海茨（Renaud Heitz）决定成立Exotec，打造一种不同类型的机器人仓库。这家法国公司开发了一个三维系统，用的是名为Skypod的机器人。它们看起来和Kiva有点像，也是在仓库地上移动。但Skypod不是移送货架，而是爬上去。爬到所需高度它就会取出一个板条箱，然后爬下来送到分拣站。

莫林说，Skypod最大限度地利用了仓库空间，因为它们可以爬上12米高的货架。由于系统是模块化的，可以轻松扩展。Skypod不仅能把板条箱送回货架，还可以把它们转移到重新装货的地方。

一些零售商已经开始使用Skypod，包括法国大型超市集团家乐福、美国服装公司GAP和日本服装公司优衣库。因为这些机器人移动迅速（Skypods每秒可行进4米，也就是每小时14公里），有可能造成人员伤害，所以它们往往在封闭区域内运行。如果亚马逊的人类员工需要进入机器人区域，他们会穿上特殊的安全背心。背心里装有电子设备，可向近旁的机器人发出信号，表明此处有人。机器人会暂停行进，或改走另一条路线。

但有些机器人设计的初衷是与人类一道在仓库中工作。常见的工作模式是由人类员工从货架和托盘中取出货品，再由机器人传送给负责将它们放入袋子和箱子中以备运输的员工。这样的系统可以免除安装固定基础设施的成本，可以快速重新配置仓库，这对为多个零售商配送、并且需要处理不断变化的产品线的物流中心来说很有用。

然而，当机器人融入人群里工作，它们必须配备摄像头、雷达和其他传感

器等额外的安全系统，以避免碰撞人。因此，它们往往行动缓慢、小心谨慎，这可能导致机器人频繁停顿，拖慢操作速度。不过，功能更强大、更能感知周围环境的机器人即将上岗。

例如，日本电气公司NEC已开始使用“风险敏感随机控制技术”，这种软件类似于金融领域里避免高风险投资的程序。不过在仓储场景下，它可以让机器人在采取任何行动之前权衡风险，例如选择穿过仓库的最安全、最快速的路线。NEC表示，在测试中，该软件在不影响安全的情况下将机器人的平均速度提高了一倍。

| 新花招

仓库中最难自动化的工作是拣货和打包，因此在旺季需要增加人手。要用机器人来完成这些工作很不容易，因为履单中心存放了难以计数的各类商品，形状、尺寸和重量都各不相同。

尽管如此，亚马逊、奥卡多、Exotec和其他公司已经开始在一些分拣站安装机械臂来实现自动化分拣。这些机械臂一般是用摄像头和读取条形码来识别商品，用吸盘等机制拣货。人们用机器学习这种人工智能技术来教机器人如何处理特定的商品，例如不要把土豆放在鸡蛋上面。

奥卡多也在开发一种机械臂，可以绕过分拣站，直接从“蜂巢”的板条箱中取出货品。硅谷的物流机器人生产商“抓取机器人”（Fetch Robotics）开发了一种可以在履单中心四下移动的拣货机械臂，该公司去年被计算公司斑马技术（Zebra Technologies）收购。

另一家马萨诸塞州的机器人制造商波士顿动力（Boston Dynamics）推出了一款名为Stretch的重型移动机器人，它可以给货车卸货并把箱子放上托盘。1月26日，物流巨头DHL下了首张Stretch订单，将在未来三年内在其北美仓库中部署这种机器人。

这样的时间表揭示仓储机器人的发展不会太快。英国分析公司IDTechEx新发布了一份有关仓储机器人技术的报告，作者李泽豪（音译）估计，机器人能开始熟练地分拣和包装货物需要10到15年时间。一些公司认为，它们

的机器人将能够在未来几年内分拣80%左右的货物，尽管这在很大程度上待视不同业务涉及的商品种类。

如果一台机器人主要是设计来抓取包装规整的商品，那它可能很难抓住香蕉或松散的蔬菜等形状不规则的物体。它能抓起的重量可能也有限，因此难以搬动平板电视或沉重的桶装啤酒。在更久远的未来可能会出现能够克服许多这些限制的系统，例如多臂机器人。

那还能剩下什么岗位给人类呢？至少在仓库里，留下来的人主要会是维护和修理机器人的技术人员，李泽豪说。他认为可能还会留几个人来监督机器人的工作，在机械兄弟们碰到它们仍旧应付不了的问题时伸出援手。而一旦开始启用无人驾驶货车，不光是在仓库内，仓库外的人类岗位也会流失。届时，许多产品在供应链中流转和送货上门都将无需人类经手。

生产机器人也还是会雇用人类。亚马逊机器人公司的新工厂将新创造200多个制造业岗位，尽管相比亚马逊自第一批机器人进入其履单中心以来创造的超过100万个工作岗位，这个数字微不足道。很多这样的岗位势必会消失，尽管其中很多工作单调又费力——这也是它们难以招到人的原因。

不过，还会出现其他工作。技术变革必然会为人类创造出新角色。上世纪60年代有成千上万的电话总机接线员，而自从交换机自动化以来，这个工种已消失殆尽。但电信行业其他的工作岗位数量猛增。自动化程度的提高提升了物流效率，网上业务也不断增长，因此电子商务的整体就业水平应该仍会提高。未来将有许多不同类型的机器人，也会有很多不同类型的工作。■



The glass-ceiling index

How the pandemic has affected working women

More women are climbing the corporate ladder. But more are also dropping off it

WOMEN IN BUSINESS have broken three records of late. The number of female bosses at the helm of Fortune 500 companies in America is at an all-time high of 41. In 2021 CVS Health, the country's fourth-biggest firm by revenue, became the largest to be run by a woman, Karen Lynch (pictured). And for the first time, two giant businesses—Walgreens Boots Alliance, another chemist, and TIAA, a financial-services firm—are run by black women.

In America and other well-off places businesswomen are making strides, according to The Economist's glass-ceiling index, an annual snapshot of female empowerment. Their share of board seats is rising in most places (though it has dipped since 2019 in progressive Sweden). Female boardroom representation surged in the Netherlands and Germany after they introduced mandatory quotas. But laws aren't everything. The British government's voluntary targets have also boosted the share of women on the boards of FTSE 100 companies, from 12.5% a decade ago to nearly 40%. Investors who care about environmental, social and governance factors are increasingly pressing firms to treat male and female employees equally.

Still, businesswomen have a long way to go before they catch up with their male counterparts, especially in the upper reaches of corporate hierarchies, and in some respects trail their female colleagues in politics (see chart). Men still occupy more than two in three boardroom seats in America. In South Korea, they hog more than nine in ten. Women continue to earn less than their male colleagues (never mind that girls outperform boys at school across the OECD, a club of mostly rich countries). In America outcomes are worse still for women of colour, who make less than white women and are

even more under represented in senior roles.

More troubling still, too many women are dropping off the corporate ladder altogether. Although remote work made it easier for some women to combine work with family chores (still performed mostly by mothers and wives), the pandemic has pushed a disproportionate number of them out of the workforce. Women's labour-force participation in OECD countries declined from 65% before covid-19 first hit to 63.8% a year later. Stymying female advancement may be yet another insidious consequence of the virus. ■



玻璃天花板指数

新冠疫情对职业女性的影响

沿企业阶梯升级的女性更多了，但一整个跌落下来的也多了

近来商界女性打破了三项记录。目前《财富》美国500强公司的CEO中有41位女性，数量达到历史新高。2021年，美国按收入计第四大公司西维斯健康（CVS Health）由凯伦·林奇（Karen Lynch，见上图）出任CEO，成为女性掌舵的最大企业。与此同时，首次有黑人女性领导500强公司，包括另一家连锁药房沃博联（Walgreens Boots Alliance）和金融服务公司TIAA。

根据本刊对女性赋权的年度评估结果——玻璃天花板指数，在美国和其他富裕地区，商界女性正大步前进。在大多数地区，董事会中的女性比例不断上升（不过在开明的瑞典，该比例自2019年以来有所下降）。荷兰和德国在出台强制性配额制度后，董事会中的女性代表激增。但法律只是一个方面。英国政府的自愿目标也提高了富时100指数公司董事会中的女性占比，从十年前的12.5%提高至近40%。关注环境、社会和治理因素的投资正越来越多地敦促公司平等对待男女员工。

然而在商界，女性追赶男性同行的道路依然漫长，特别是在高层职位上。而且在某些方面，商界女性的发展不如政界女性（见图表）。在美国，超过三分之二的董事席位仍由男性占据。在韩国，该比例超过九成。女性的收入仍低于男性同事（尽管纵观主要由富国组成的经合组织，女孩的学业表现优于男孩）。在美国，有色人种女性的境况更不理想，不但收入低于白人女性，担任高级职务的比例也更低。

更令人不安的是，有太多女性正完全从职场阶梯上跌落。尽管远程工作让部分女性能更方便地兼顾工作和家务（仍主要由母亲和妻子操持），但疫情把过多的女性挤出了劳动力市场。在经合组织国家，女性的劳动力参与率从疫情爆发之初的65%下降到一年后的63.8%。阻碍女性进步可能是疫情的又一个潜在恶果。■



Grain damage

War in Ukraine will cripple global food markets

The share of incomes spent on staples is about to jump everywhere

IN OCTOBER 1914 the Ottoman Empire, having just joined the first world war, blockaded the Dardanelles Strait, the only route for Russian wheat to travel to Britain and France. The world had entered the conflict with wheat stocks 12% above the five-year average, but losing over 20% of the global traded supply of the crop overnight set food markets ablaze. Having risen by a fifth since June 1914, wheat prices in Chicago, the international benchmark, leapt by another 45% over the following quarter.

Today Russia and Ukraine, respectively the largest and fifth-largest wheat exporters, together account for 29% of international annual sales. And after several poor harvests, frantic buying during the pandemic and supply-chain issues since, global stocks are 31% below the five-year average. But this time it is the threat of embargoes from the West that has lit a bonfire—and the flames are higher than even during the Great War. Wheat prices, which were already 49% above their 2017-21 average in mid-February, have risen by another 30% since the invasion of Ukraine started on February 24th. Uncertainty is sky-high: indicators of price volatility compiled by IFPRI, a think-tank, are flashing bright red.

Rabobank, a Dutch lender, reckons wheat prices could climb by another third. But the damage to global food supply will extend far beyond the grain—and last longer than the war itself. Together Russia and Ukraine export 12% of the calories traded worldwide. They rank among the top five exporters of many oilseeds and cereals, from barley and corn to sunflowers, consumed by humans and animals. Russia alone is the biggest supplier of key ingredients in the making of fertilisers, without which crops falter or lose nutrients.

In February, even before the war started, a food-price index compiled by the UN Food and Agriculture Organisation had reached an all-time high; the number of people deemed food-insecure, at 800m, was at its highest for a decade. Many more could soon join them. Higher food prices will also stoke inflation, adding to the price pressures generated by dearer energy.

The fallout from the war will be felt in three ways: disruption to current grain shipments, low or inaccessible future harvests in Ukraine and Russia, and withered production in other parts of the world. Start with shipments. In normal times wheat and barley crops are harvested in the summer and exported in the autumn; by February most ships are gone. But these are not normal times: with global stocks low, big importers of Black Sea wheat, chiefly in the Middle East and North Africa, are anxious to secure more supplies. They are not getting them. Ukrainian ports are shut. Some have been bombed. Inland routes, via the north of Ukraine and onwards through Poland, are too great a diversion to be practical. Vessels trying to pick up grain from Russia have been hit by missiles in the Black Sea. Most cannot get insurance.

Alternative sources are unaffordable. In early March Egypt cancelled its second wheat tender in a row after receiving only three offers—at a stomach-churning price—down from 20 a fortnight before. More concerning still, exports of corn, of which Ukraine accounts for nearly 13% of global exports, usually take place through the spring until the early summer. Much of it is normally shipped from the port of Odessa, which is bracing for a Russian assault.

Future crops are an even bigger worry. In Ukraine the war may result in lower yields and area planted. Winter crops such as wheat and barley, which are sown in October, could be smaller because of a lack of fertiliser and pesticides. Spring crops such as corn and sunflowers, the planting of which would normally start imminently, may not get sown at all. Leonid

Tsentilo, whose farm in central Ukraine grows 7,000 tonnes of wheat a year, says local prices for diesel and plant-protection products have risen by 50% in two weeks. Some of his workers have been shipped off to war.

In Russia the risk is not curtailed production but blockaded exports. Although food sales are not yet subject to sanctions, Western banks are reluctant to lend to traders. Fear of being fined by governments in the West or shamed by its press is keeping merchants at bay. While Ukraine is “unreachable”, Russia is “untouchable”, says Michael Magdovitz of Rabobank.

Most alarming will be the conflict’s impact on agriculture worldwide. The region is a big supplier of critical fertiliser components, including natural gas and potash. Fertiliser prices had already doubled or tripled, depending on the type, even before the war, owing to rising energy and transport costs and sanctions imposed in 2021 on Belarus, which produces 18% of the world’s potash, as it cracked down on dissidents. As Russia, which accounts for 20% of global output, finds it harder to export its own potash, prices are sure to rise further. Since four-fifths of the world’s potash is traded internationally, the impact of price spikes will be felt in every agricultural region in the world, warns Humphrey Knight of CRU, a consultancy.

As a result of all this, a much greater share of incomes will soon be spent on food (see chart). This will be felt most acutely in the Middle East, Africa and parts of Asia, where some 800m people depend heavily on Black Sea wheat. That includes Turkey, which supplies much of the southern Mediterranean with flour. Egypt usually buys 70% of its wheat from Russia and Ukraine. The latter alone accounts for half of Lebanon’s wheat imports. Many others can hardly do without Ukraine’s corn, soyabeans and vegetable oil.

Meanwhile higher fertiliser and energy costs will crimp farmers’ margins everywhere. Brazil, a huge producer of meat and agricultural products,

imports 46% of its potash from either Russia or Belarus, says Cristiano Veloso of Verde AgriTech, a Brazilian startup. Eventually some of the costs will be passed on to the consumer.

Protectionism may pour more fuel on the fire. National restrictions on fertiliser exports increased last year and could accelerate. Limits on food exports, or panic-buying by importers, could trigger a price spike of the kind that sparked riots in dozens of countries in 2007-08. On March 8th and 9th, respectively, Russia and Ukraine banned wheat exports. Argentina, Hungary, Indonesia and Turkey have announced food-export restrictions in recent days.

There is no easy fix. Some of the 160m tonnes of wheat used as animal feed every year could be diverted for human consumption, but substitution may export inflation to other staples. Increasing production in Europe and America and drawing on India's vast strategic stockpile may yield 10-15m tonnes—a substantial quantity, but less than a third of Ukraine's and Russia's combined annual exports. Some could come from farther afield but there are bottlenecks: efforts to export more of Australia's bumper winter-wheat crop have clogged the supply chains between its farms and ports. With corn, governments may resort to appropriating some of the 148m tonnes used as bioethanol feed to help plug this year's likely shortfall of 35m tonnes. Fertiliser shortages are even harder to cover: new potash mines take 5-10 years to build.

The war in Ukraine is already a tragedy. As it ravages the world's breadbasket, a calamity looms.

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谷物损伤

乌克兰的战争将损害全球食品市场

在所有地方，主粮支出占收入的比重都将大幅上升

一九一四年十月，刚刚加入第一次世界大战的奥斯曼帝国封锁了达达尼尔海峡——俄罗斯小麦运往英国和法国的唯一通道。世界刚进入这场战争时，小麦库存比五年平均水平高12%，但一夜之间失去小麦全球贸易供应量的超过20%给粮食市场放了一把火。作为国际基准的芝加哥小麦价格自当年6月已经上涨了五分之一，在接下来的一个季度里又暴涨了45%。

今天，分别是世界第一大和第五大小麦出口国的俄罗斯和乌克兰合计贡献了国际年销量的29%。而在经过几次歉收、疫情期间的物资抢购潮以及之后的供应链问题，全球库存比五年平均水平低了31%。但这次放了一把大火的是来自西方的禁运威胁——而且火焰窜得甚至比一战时还要高。小麦价格在2月中旬就已经比2017到2021年的平均水平高出49%，自2月24日俄罗斯入侵乌克兰以来又上涨了30%。不确定性高出天际：智库国际食物政策研究所（IFPRI）编制的价格波动指标大亮红灯。

荷兰合作银行（Rabobank）估计小麦价格可能会再上涨三分之一。但是，全球食品供应遭受的损害将远不止于小麦——而且持续的时间会比战争本身更久。俄罗斯和乌克兰合计出口了12%的全球交易的食物。在人和动物食用的许多油籽和谷类（如大麦、玉米和向日葵等）上，两国都在五大出口国之列。俄罗斯还是化肥关键生产原料的最大供应国，没有化肥，农作物就会枯萎或失去养分。

2月，战争还没开打，由联合国粮农组织编制的食品价格指数就已达到历史高点；被认为处于粮食不安全状态的人数达到八亿，为10年来最高水平。这个人群可能还会大幅增加。食品价格上涨还会加剧通货膨胀，加大能源价格上涨带来的价格压力。

人们将从三个方面感受到这场战争的影响：眼下的粮食运输中断；乌克兰

和俄罗斯未来的收成很低或无法购买；世界其他地区粮食产量下降。先看运输。在正常时期，小麦和大麦在夏季收割，在秋季出口；到了2月，大多数船只都已消失不见。但现在不是正常时期。随着全球库存的减少，主要在中东和北非的黑海小麦进口大国迫切想要确保更多供应。它们不会如愿。乌克兰的港口关闭，有些已经被轰炸。若要走经由乌克兰北部穿越波兰的内陆路线，绕的弯就太大了，不切实际。已有试图从俄罗斯装载谷物的船只在黑海被导弹击中。它们大多数都无法获得保险。

另觅供应源的成本难以负担。3月初，埃及连续第二次取消小麦招标，它仅收到了三份报价（两周前的那一轮收到20份），且价格高得令人心惊肉跳。更令人担忧的是，玉米出口（乌克兰占全球出口量的近13%）通常在春季开始，持续到初夏。其中大部分通常从敖德萨港装运，而那里正准备应对俄罗斯的袭击。

未来的农作物供应更是乌云密布。在乌克兰，战争可能导致产量和种植面积下降。由于化肥和杀虫剂短缺，10月份播种的小麦和大麦等冬季作物可能会减产。玉米和向日葵等春季作物原本马上就要开始播种了，但可能根本就不会下种了。里奥尼德·赞提洛（Leonid Tsentilo）位于乌克兰中部的农场每年生产7000吨小麦，他说当地柴油和作物保护剂的价格在两周内上涨了50%。他的一些工人已经被送上战场。

在俄罗斯，风险不是减产，而是出口受阻。尽管食品销售尚未受到制裁，但西方银行不大愿意贷款给贸易商。商人害怕被西方政府罚款或遭媒体羞辱，因而按兵不动。荷兰合作银行的迈克尔·马格多维茨（Michael Magdovitz）说，乌克兰是“触不可及”，而俄罗斯是“碰不得”。

最令人担忧的将是这场战事对全球农业的影响。该地区是包括天然气和磷酸钾在内的化肥关键成分的主要供应地。早在战争爆发前，由于能源和运输成本的上升，加上生产了全世界18%磷酸钾的白俄罗斯在2021年因镇压异见分子而遭制裁，不同种类的化肥价格就已经涨了一倍或两倍。随着占全球产量20%的俄罗斯出口磷酸钾的难度加大，价格肯定还会再涨。咨询公司CRU的汉弗莱·奈特（Humphrey Knight）警告说，由于世界上五分

之四的磷酸钾都是在国际上交易的，价格飙升的影响将会波及世界上每一个农业地区。

所有这一切的结果是人们花在食物上的收入占比很快会大幅增加（见图表）。中东、非洲，以及亚洲部分地区将有最强烈的感受，那里约有八亿人严重依赖黑海小麦。其中的土耳其为南地中海的大部分地区供应面粉。埃及的小麦供应通常有七成购自俄罗斯和乌克兰。黎巴嫩的小麦供应一半购自乌克兰。其他许多国家几乎也离不开乌克兰的玉米、大豆和植物油。

与此同时，化肥和能源成本升高将挤压世界各地农民的利润。肉类和农产品生产大国巴西46%的磷酸钾进口自俄罗斯或白俄罗斯，巴西创业公司Verde AgriTech的克里斯蒂亚诺·贝洛索（Cristiano Veloso）说。最终一部分成本将转嫁到消费者头上。

保护主义可能会火上浇油。化肥出口的国家限制令去年有所增加，而且可能还会加速推出。对食品出口的限制或进口商的恐慌性购买可能引发价格飙升，就像2007到2008年在几十个国家引发了骚乱的那轮粮价危机。俄罗斯和乌克兰分别在3月8日和9日叫停了小麦出口。阿根廷、匈牙利、印度尼西亚和土耳其近日宣布实施食品出口限制。

没有简单的解决办法。可以将每年用作动物饲料的1.6亿吨小麦中的一部分转为供人类消费，但寻求替代品可能会将通胀转嫁到其他主食上。欧美增产加上利用印度巨大的战略储备可能会得到1000万到1500万吨的产出——数量很可观，但还不到乌克兰和俄罗斯年出口小麦总量的三分之一。或许可以从更远的地方获取部分供应，但这存在瓶颈：人们尝试扩大澳大利亚丰收的冬小麦的出口，结果堵塞了农场和港口之间的供应链。至于玉米，各国政府可能会从用作生物乙醇原料的1.48亿吨中挪出一些来填补缺口——今年很可能会缺3500万吨。化肥短缺更难填补，因为新的钾矿需要五到十年才能建成。

乌克兰战争已经是一场悲剧了。而随着它摧残世界粮仓，一场灾难正在逼近。





The Economist Film

The true costs of ageing - part 2

Ageing populations threaten societies with shrinking workforces, economic stagnation and crippling costs for pensions and care. Simply throwing money at the issue is not going to be enough.



经济学人视频

老龄化的真实代价（下）

人口老龄化导致的社会冲击包括劳动人口萎缩、经济停滞、高昂的养老金和护理成本。仅靠砸钱并不足以解决即将到来的问题。



A brief history of Londongrad

A new book shows how Britain came to welcome dirty money

In “Butler to the World”, Oliver Bullough calls for principles over profit

Butler to the World. By Oliver Bullough. St Martin’s Press; 288 pages; \$28.99. Profile Books; £20

EVEN AFTER the annexation of Crimea in 2014, the leak of the Panama Papers in 2016 and the poisoning of Sergei Skripal two years later, London remained a haven for “Moscow gold”. Britain has been hospitable to Russian money, much of it tainted, since the Soviet Union collapsed. What, wondered anti-corruption campaigners and concerned MPs, would it take for their country to get tough on the oligarchs and Kremlin cronies whose acquisition of mansions and football clubs had earned the capital the nickname Londongrad?

Just possibly, the answer is a big war in Europe. After Russia’s latest invasion of Ukraine, Boris Johnson’s government has piled sanctions on the Russian companies, banks and tycoons it sees as supporters of Vladimir Putin. After years of delay, a new economic-crime bill that will, for instance, make foreign owners of British property reveal their identities, is being rushed into law. Even now, though, questions linger about the clean-up’s thoroughness.

One of the best-informed sceptics is Oliver Bullough. His new book is an urgent account of Britain’s history of welcoming corrupt capital. By the end, readers will sneer at the claim of successive British governments that, as Mr Johnson has put it, no country “could conceivably be doing more to root out corrupt Russian money”. The gulf between rhetoric and reality has been chasmic.

Mr Bullough's thesis is that London became a favoured destination for dodgy dough not by chance but by design. For over half a century, Britain's business model has been to act as the butler of his title to oligarchs, gangsters and kleptocrats looking for a safe place to park their often ill-gotten gains and enjoy the high life.

Like the versatile and creative Jeeves of the P.G. Wodehouse stories, the British have developed an impressive range of apt skills. The National Crime Agency reckons Britain has a £100bn-a-year money-laundering problem; London's luxury-property market serves as storage for much of this loot. Should anyone ask awkward questions, reassuringly expensive lawyers and public-relations firms have been only too happy to shoo them away, aided by plaintiff-friendly libel and privacy laws. Foreign billionaires with chequered pasts have worked hard and spent big to penetrate the British establishment. It has embraced many of them, even doling out the odd knighthood or peerage.

To understand all this, argues Mr Bullough, you have to go back to 1956, and the Suez fiasco. It worsened a sterling crisis that led to the development of "euromarkets", unregulated finance in dollars and other currencies outside their home countries. In turn those led to the blossoming of what has been called "Britain's second empire": a network of secretive offshore financial centres hosted by British overseas territories, such as the British Virgin Islands (BVI) and Cayman Islands, which by the 1980s were feeding big sums into the City. The British seemed to understand better than anyone that if you wanted to attract footloose capital, you had to treat its owners well—which meant being discreet.

Mr Bullough's previous book, "Moneyland", gave an eye-opening and entertaining tour of the world's hubs for tax-dodgers and money-rinsers. Focusing on Britain in his follow-up is a statement in itself. Most of his chapters are devoted to a particular butlering characteristic. One covers the

BVI's rise from a backwater largely reliant on sales of postage stamps to a mass-producer of shell companies for Russian and Chinese clients. Another dissects the mysterious purchase of a disused Tube station in London by a Ukrainian tycoon; he became pally with British luminaries before moving to Vienna, where he is fighting extradition to America for alleged corruption (Britain has filed no charges).

The most revealing chapter is on the "Scottish limited partnership" (SLP). This arcane corporate form has featured in some of the most notorious "laundromat" cases, involving industrial-scale washing of money from former Soviet countries; in one, a criminal group stole \$1bn from banks in Moldova, more than an eighth of the country's GDP. The wheeze owes its popularity to a single sentence in a law of 1890, which defines the SLP as "a legal person distinct from the partners of whom it is composed". It thus provides a buffer between miscreant and misdeed that is unavailable in regular partnerships—should anyone be so indelicate as to pry.

One of the few who did pry was David Leask, a journalist with the Herald, a Scottish newspaper. His work led to calls from Westminster MPs to end the ruse; the government vowed action. Business had other ideas. Associations representing lawyers and estate agents cautioned that a crackdown would create bad publicity and impose extra burdens on legitimate businesses. Moneymen warned it could harm the City's competitiveness. An umbrella group for private equity, which had long used SLPs in its (legal) tax-avoidance arrangements, counselled against a "needless act of national self harm". All this played on ministers' fears of blunting Britain's financial edge and, as often before, it worked: it is still possible to own SLPs anonymously and avoid filing accounts.

To be fair, British politicians have had their moments in the fight against dirty money. One came when, as prime minister, David Cameron hosted a global anti-corruption summit in 2016. He also pushed through reforms

including a public register of company owners, the first in a G20 economy. But momentum stalled with the distractions of Brexit and covid-19.

| *Closing the laundry*

Britain's perennial trouble is less shoddy laws than a lack of resources to enforce them vigorously. Mr Cameron's ownership register is an example. Companies House, which runs it, cannot afford to vet the information submitted, let alone go after those who file fibs. The combined budget of national agencies that fight economic crime is a paltry £850m (\$1.12bn), says a watchdog—less than 1% of the amount estimated to be laundered through the country annually. Ministers have announced various anti-corruption outfits and initiatives but failed to provide the funding to give them real clout. The country has no credible equivalent to the punch-packing units in several American agencies.

On the rare occasions when British prosecutors get the bit between their teeth in white-collar cases, they are more likely to involve corporate fraud than cross-border corruption. When they do pursue big-time graft, they are typically outgunned by the blue-chip lawyers hired by their deep-pocketed targets. Witness “unexplained wealth orders”, a sensible legal innovation introduced in Britain in 2018, which allow assets to be seized if their owners cannot prove they were bought with legitimate funds. Of the four cases so far, one has already been overturned. Prosecutors are hamstrung by the high legal bar for the confiscation of assets. According to an index of property rights, they enjoy stronger protection in Britain than in any other European country—one reason why oligarchs are so fond of English courts.

Ultimately, Mr Bullough sees a mystery at the core of the servile business model. What does the country get out of it? True, some lawyers, PR consultants and estate agents do very nicely. But the earnings from oligarchs and other foreign patrons of London's offshore machinery and swankiest neighbourhoods are tiny compared with the overall revenues of

the City. Meanwhile, the reputational risks of a model that sucks in cash from benighted kleptocracies have never been clearer.

Begging your neighbours for relatively little gain—call it Cruel Britannia—is not a good look. Whether the efforts of campaigners, combined with the stench around Londongrad since the assault on Ukraine, help put an end to Butler Britain remains to be seen. Mr Bullough argues compellingly that though more anti-corruption funds and tougher enforcement are welcome, what is really needed is a change of philosophy: for principles to take precedence over the profits of a few. ■



伦敦格勒简史

一本新书展示了英国是如何开始欢迎脏钱的

在《世界的管家》中，奥利弗·布洛呼吁原则应高于利润【《世界的管家》书评】

《世界的管家》，奥利弗·布洛著。圣马丁出版社，288页，28.99美元。
Profile Books出版社，20英镑。

伦敦一直是“莫斯科黄金”的避风港，即使在发生了2014年俄罗斯吞并克里米亚、2016年巴拿马文件泄露、两年后谢尔盖·斯克里帕尔（Sergei Skripal）遭毒杀之后，这一点也没有改变。自苏联解体以来，英国一直欣然接受来自俄罗斯的资金，其中很多都不干净。俄罗斯的寡头和克里姆林宫的亲信在英国购买豪宅和足球俱乐部，让伦敦得了个“伦敦格勒”的绰号，反腐运动人士和对此表示担忧的议员想知道，自己的国家要怎样才会对这些人采取强硬措施呢？

或许，答案是欧洲的一场大战。在最近俄罗斯入侵乌克兰后，约翰逊政府对它认为支持普京的俄罗斯公司、银行和大亨实施了一系列制裁。英国正在快速通过一项拖延了多年的新经济犯罪法，其中包括规定在英国拥有财产的外国人必须披露身份。然而，即使是现在，这场清理的彻底性仍然存疑。

怀疑派当中的消息灵通人士之一是奥利弗·布洛（Oliver Bullough）。他的新书急切地讲述了英国欢迎腐败资本的历史。历届英国政府都声称在不遗余力地清理腐败资本，约翰逊的说法是想象不出有哪个国家能比英国“在根除俄罗斯的腐败资金上做得更多”。读完这本书，读者将会对此嗤之以鼻。高谈阔论与现实之间的鸿沟是如此巨大。

布洛的论点是，伦敦成为不明来源资金的首选目的地并非偶然，而是有意为之。半个多世纪以来，英国的商业模式一直是充当寡头、黑帮和贪官污吏的管家，这些人需要安全的地点来存放他们那些往往是不义之财的资金和享受奢靡生活。

就像伍德豪斯（P.G. Wodehouse）笔下多才多艺又办法多多的管家吉夫斯一样，英国人已经发展出了一系列令人赞叹的适用技能。英国国家犯罪调查局（National Crime Agency）估计，英国的洗钱规模达每年1000亿英镑，而伦敦的豪宅市场成为存放大部分脏钱的地方。如果有人提出难堪的问题，在利于原告的反诽谤法和隐私保护法的帮助下，收费高到叫人安心的律师和公关公司会很乐于把这些人打发掉。有过不光彩历史的外国亿万富翁一直在努力钻营，大把撒钱打入英国上流社会，其中许多人已被接纳，有几个甚至还获封了爵士或贵族头衔。

布洛认为，要弄明白这一切，必须回溯到1956年英国在苏伊士运河危机中的惨败。它加剧了英镑危机，英镑危机又导致了“欧洲市场”的发展，也就是以美元和其他货币在它们本国以外市场开展的不受监管的金融活动。这反过来又推动了所谓“第二英帝国”的蓬勃发展，即位于英属维尔京群岛和开曼群岛等英国海外属地的秘密离岸金融中心网络。到了80年代，这个网络已经在向伦敦金融城输送大笔资金。英国人似乎最清楚，想要吸引到处游走的资本，就必须善待资本的所有者——那就是谨慎识趣，少管少问。

在他上一本书《财富大陆》（Moneyland）中，布洛带领读者游历了世界各地的逃税和洗钱天堂，内容生动有趣，令人大开眼界。他在自己的下一本书中把目光聚焦英国，这本身就传达了信息。这本书的大部分章节都在讨论某一种管家特质。其中一章讲的是英属维尔京群岛的变身过程，该群岛以前是一个主要以卖邮票为生的落后地区，后来成了服务俄罗斯和中国客户的空壳公司批量制造地。另一章剖析了一名乌克兰大亨购买伦敦一个废弃地铁站的神秘交易，这名大亨与许多英国名人过往甚密，后来移居维也纳，被当地法院裁定需引渡到美国就腐败指控受审（英国没有提出任何指控），目前正为此上诉。

最具揭露性的一章讲的是“苏格兰有限合伙制”（SLP）。这种神秘的公司形式出现在一些最臭名昭著的洗钱案件中，涉及对前苏联国家流出资金的大规模洗白。其中有一宗，一个犯罪团伙从摩尔多瓦的几家银行窃取了10亿美元，超过该国GDP的八分之一。这种公司形式之所以如此受青睐，是因为在1890年的一项法律中，有一句话把SLP定义为“与其合伙人不同的法

人”。因此，它可以将不法之徒和不法行为隔离开来，以防好事之徒的刺探，而这在一般合伙制公司中是无法做到的。

苏格兰《先驱报》的记者大卫·利斯克（David Leask）就是为数不多的刺探者之一。他的调查导致英国国会议员呼吁终结这种诡计。政府誓言要采取行动，而商界却另有想法。代表律师和房地产经纪人的协会警告说，打压SLP会造成负面影响，给合法企业带来额外负担。金融界人士警告说，这可能会损害伦敦金融城的竞争力。一个长期利用SLP（合法）避税的伞型私募集团反对“国家采取不必要的自残行为”。大臣们原本就担心英国的金融优势会被削弱，这些言论都在操纵这种心理，而且和以往一样达到了目的。所以现在仍然可以匿名拥有SLP，而且不必提交账目信息。

公平地说，英国政客在打击脏钱方面也曾有过高光时刻。2016年，时任首相卡梅伦主持了一场全球反腐峰会。他还推动了相关改革，其中包括公开登记公司所有人这一措施，领G20经济体之先。但随着英国脱欧和新冠疫情分散了注意力，改革陷入了停滞。

| 关掉洗钱房

英国的痼疾与其说是法律漏洞太多，不如说是缺乏严格执法的资源。卡梅伦推动的所有权登记就是一个例子。负责登记的公司注册处（Companies House）没有足够的资源来审查所有提交的资料，更不用说追查提交虚假资料的公司了。一家监督机构表示，英国各政府部门用于打击经济犯罪的预算加起来才区区8.5亿英镑，还不到每年英国洗钱估计总额的1%。大臣们宣布成立各种反腐机构，推出相应举措，但未能提供资金让它们真正发挥作用。美国政府机构里有几个能够重拳出击的部门，英国没有可靠的对等部门。

当英国的检察官们罕有地要坚决处理白领案件时，这类案子更多涉及企业欺诈，而不是跨境腐败。而到真要起诉重大贪腐案时，他们通常又会被财力雄厚的被告高价聘请的一流律师击败。看看《不明来源财富法令》（Unexplained Wealth Orders）就知道了。这是2018年英国出台的一项明智合理的法律创新，它规定如果所有者无法证明其资产由合法资金购

得，可被没收相关资产。迄今为止共审理过四起相关案件，其中一起已被推翻。没收资产的法律门槛很高，束缚了检察官们的手脚。一个产权指数显示，产权在英国受到的保护强于任何其他欧洲国家，这也是寡头如此钟情英国法院的原因之一。

最终，布洛发现这种逢迎的商业模式有一个核心之谜：英国从中得到了什么？诚然，一些律师、公关和地产经纪获利丰厚。但与伦敦金融城的总收入相比，寡头和其他外国主顾在伦敦的海外属地和奢华社区贡献的收入微不足道。而与此同时，这种从蒙昧的窃盗统治中吸取现金的模式所带有的声誉风险却前所未有地清晰显现了。

为了相对很小的好处让邻国陷入困顿，这种“冷酷不列颠”的吃相可不太好看。活动人士的不断努力，再加上俄罗斯入侵乌克兰后伦敦格勒臭名昭著，是否能让“英国管家”退位，还有待观察。布洛令人信服地提出，虽然增加反腐资金、加强执法会有帮助，但真正需要的是改变理念——让原则高于少数人的利益。■



Free exchange

How oil shocks have become less shocking

Soaring crude prices stoke fears of recession, but the global economy looks resilient

THE OMENS are bad for the world economy. When oil prices surge, growth typically moves in the opposite direction. Sometimes the price shock begins with a political earthquake, like the Suez crisis of 1956. Sometimes oil producers deliberately create the shock, as with the OPEC embargo of 1973. And sometimes the culprit is soaring demand, such as when oil prices hit record highs in 2008. The common denominator in all these cases is that America and most other rich countries soon enough faced recessions.

So it would hardly be surprising if the current surge in oil prices—a doubling in three months, fuelled by Russia's invasion of Ukraine—foreshadows a sharp downturn in growth. Pictet, an asset manager, counts six episodes since 1970 in which real oil prices rose by more than 50% from their previous trend; each preceded a recession. As of late February oil prices had already surpassed this 50% threshold, and have only climbed higher since then.

Nevertheless, the easily observed relationship between oil and the economy is no iron law. There have been times when crude prices soared and yet recessions were averted, including the peak of a global commodities boom in 2011. The type of shock matters, as does the economic backdrop. Moreover, much of the world appears to have become better insulated from oil markets over time. Old dismal patterns may not perfectly repeat themselves.

Consider the mechanics by which rising oil prices hurt growth. Energy is an important factor of production, so a sharp decrease in its supply or increase in its price may drag down output. It may also hurt demand: if people

spend more of their incomes on oil, less is left over for other things. Add to this the possibility that central banks may tighten monetary policy aggressively when higher oil prices push up inflation, as the Federal Reserve did following the OPEC crisis of 1973 and the Iranian revolution of 1979.

Yet no two oil shocks are the same. A critical variable is whether the shock stems from the economy's supply side or demand side. If there is a sudden shortfall in supply, as during an embargo, that functions as a new tax on production and consumption. If, however, robust demand is the cause, rising oil prices reflect economic vitality. Lutz Kilian, an economist with the Fed's branch in Dallas, has shown that broad demand strength can, for a time, outweigh the negative effects of higher oil prices. A pure supply shock is, by contrast, more harmful. The period since the pandemic struck has featured a bit of both. The quadrupling in crude prices from the spring of 2020 to the start of 2022 reflected growth roaring back from its pandemic-induced slowdown. Only the most recent surge is unquestionably a supply shock, caused by the Ukraine war and associated sanctions.

Three changes in the structure of the global economy may dampen the effects of the price surge. Most obviously oil's role in growth cycles is not what it used to be. In 1973 the world used nearly one barrel of oil to produce \$1,000-worth of GDP (in inflation-adjusted terms). By 2019 that was down to 0.43 barrels, with the energy intensity of growth falling annually "in an almost perfectly linear fashion", according to a report last year by the Centre on Global Energy Policy at Columbia University. A shift in economic output from industry to services is part of the explanation. The world has also become more efficient in using oil. Cars, for instance, go twice as far per gallon of petrol as in the 1970s.

A related change is the way that governments respond to oil shocks. As James Hamilton of the University of California, San Diego, has observed, in

the 1970s American officials aggravated economic dislocations with price controls on petrol, which resulted in shortages. Since 1981 they have steered clear of such controls, which has made for more volatile crude prices but smoother market adjustments. Some tweaks in behaviour have got easier thanks to the pandemic: if air fares soar, why fly to that business meeting when you can log on to Zoom instead?

Central bankers may also be less tempted to jack up interest rates simply because of soaring energy prices, thereby reducing the risks of a recession. There is a debate over whether the pass-through from oil shocks to core inflation is basically nil, as argued in a paper for the Fed by Todd Clark and Stephen Terry, or small, as argued in another Fed paper by Cristina Conflitti and Matteo Luciani. However, the experts agree that the pass-through has weakened, in part because of the diminished energy intensity of growth. Even before the war in Ukraine, the Fed was set to raise interest rates several times this year in order to rein in inflation. The salient point is that, according to market pricing, investors do not believe that the oil shock will lead to much more aggressive moves by the Fed than previously expected.

| *Shale fellow well met*

A final difference with past oil shocks is the momentous evolution of America's status in the global crude industry. In the first decade of the 2000s America imported more than 10m barrels of oil per day in net terms. With the shale revolution, American oil production has soared, such that it now meets most of its energy needs from its domestic production. In 2020 America became a net exporter for the first time since at least 1949.

One effect is that oil shocks are now less destabilising for the American economy in aggregate. Consumers may dislike rising crude prices but oil producers enjoy them. A key question in the months ahead will be the extent to which they expand drilling. That would help offset the economic loss from softer consumer spending. And for the rest of the world, a

resilient American economy would provide useful ballast amid all the turbulence. The EU must worry not just about oil but also about a much more acute shortage of natural gas. Should it join America and Britain in banning Russian imports, the price of crude could go much higher still. But at oil's current price, the world economy can, with luck, withstand the shock. ■



自由交流

石油危机何以冲击力减弱

原油价格飙升引发衰退之忧，但全球经济似乎颇有韧性

世界经济面对不祥之兆。油价飙升时，经济增长通常随之下滑。油价冲击有时是始于政治地震，如1956年的苏伊士运河危机，有时是石油生产商故意制造的，如1973年的欧佩克禁运。还有些时候，罪魁祸首是需求飙升，比如2008年油价创下历史高点的那次。这些事件的共同点是美国及其他大多数富裕国家很快就迎来了经济衰退。

所以，如果在当前油价飙升后出现经济增长急剧下滑也不足为奇——受俄罗斯入侵乌克兰的推动，油价在三个月内翻了一番。据资产管理公司瑞士百达（Pictet）统计，自1970年以来，实际油价上涨超过之前走势50%的有六次，都是在经济衰退前发生的。截至2月底，油价涨幅已经超过这个50%的门槛，而且之后继续攀升。

然而，石油和经济之间这种能被清楚观察到的关联并不是什么铁律。历史上也曾有过几个时段油价虽飙升却没有引发衰退，包括2011年全球大宗商品热潮的顶峰期。危机的类型很重要，当时的经济背景也是。而且，全球大部分地区似乎都已经能够更好地保护自己免受石油市场波动的影响。旧日的惨淡模式也许不会完全再现。

来看看油价上涨损害增长的作用机制。能源是重要的生产要素，因此它的供应急剧下降或价格急剧上升都可能拖累产出。这些情况也可能损害需求：如果人们把更多收入花在石油上，能用在其他地方的钱就少了。此外，央行可能在油价上涨推高通胀时大幅收紧货币政策，就像美联储在1973年欧佩克危机和1979年伊朗革命后的做法。

然而，没有哪两次石油危机是完全相同的。一个关键的变量是，危机是源于经济的供给侧还是需求侧。假如突然出现供应短缺，比如禁运，就会拖累生产和消费。但如果油价上升是由于需求强劲，则表明经济很有活力。

美联储达拉斯分行的经济学家卢茨·基连（Lutz Kilian）指出，全面提升的需求可以在一段时间内克制油价上涨的负面影响。相比之下，单纯的供应冲击更为有害。新冠疫情爆发至今的这段时间里，这两种情况都有所体现。从2020年春季到2022年初，原油价格翻了两番，反映出经济增长从疫情导致的放缓中强势反弹。只有距今最近的一波油价飙升无疑是一种供应冲击，由乌克兰战争和相关制裁引发。

全球经济结构的三个变化可能抑制油价飙升的影响。最明显的是，石油在增长周期中的作用已不同往日。1973年，世界每创造价值1000美元的GDP（已做通胀调整）就要消耗将近一桶石油。到2019年，随着增长的能耗强度以“近乎完美的线性方式”逐年下降，这个数字已降至0.43桶，哥伦比亚大学全球能源政策中心（Centre on Global Energy Policy）去年发表的一份报告指出。原因之一是经济产出从工业向服务业转移。世界在用油方面也已变得更高效，比如，现在汽车每加仑汽油的行驶里程是1970年代时的两倍。

一个相关的变化是政府应对石油危机的方式。正如加州大学圣地亚哥分校的詹姆斯·汉密尔顿（James Hamilton）观察到的，在上世纪70年代，美国官员管控汽油价格导致供应短缺，加剧了经济混乱。1981年后他们不再采取这类管制措施，原油价格的波动变得更加频繁，但市场调整也更平顺了。新冠疫情倒是使得人们更容易调整某些行为了：假如机票价格暴涨，为何还非要飞去会议地点，登录Zoom不也可以吗？

央行官员可能也不大再会仅仅因为能源价格飙升就加息，这就降低了经济衰退的风险。石油危机是否会传导至核心通胀还存在争论。托德·克拉克（Todd Clark）和斯蒂芬·特里（Stephen Terry）为美联储撰写的论文认为这一影响为零。由克里斯蒂娜·康弗利蒂（Cristina Conflitti）和马泰奥·卢西亚尼（Matteo Luciani）撰写的另一篇美联储论文认为有较小的影响。不过，这些专家们一致认为这种传导已经减弱，原因之一是经济增长的能耗强度降低了。在乌克兰战争爆发之前，美联储就已经在准备今年多次加息以控制通胀了。很重要的一点是，从市场定价看，投资者并不认为石油危机会导致美联储采取显著超出此前预期的激进措施。

与以往石油危机的最后一个不同点是，美国在全球石油工业中的地位发生了巨变。在本世纪头十年，美国每天净进口超过1000万桶石油。借助页岩革命，美国的石油产量急剧上升，如今它自己的产出已可满足国内大部分需求。2020年，美国自至少1949年以来首次成为石油净出口国。

这种变化的效应之一是，石油危机如今在整体上对美国经济的破坏减小了。消费者可能不喜欢油价上涨，但石油生产商对此喜闻乐见。未来几个月的一个关键问题是它们会把产能扩大到什么程度。这将有助于抵消消费者支出疲软造成的经济损失。而对世界其余地区而言，美国经济保持强韧将是这一切动荡风波的定海神针。欧盟要担心的不仅是石油，还有短缺程度严重得多的天然气。假如欧盟跟随英美对俄实施能源进口禁令，原油价格可能还会进一步飙升。但就目前的油价而言，运气好的话，世界经济是可以承受住冲击的。■



The techno-independence movement

China wants to insulate itself against Western sanctions

We assess its progress in six critical technologies

A STRIKINGLY HARSH appraisal of China's ongoing technological battle with America appeared on the website of a prestigious Beijing-based think-tank on January 30th. The paper, published by the Institute of International and Strategic Studies (IISS) at Peking University, found that China is likely to be the bigger loser from the technological and economic decoupling under way between the two world powers. China lacks control over core computing systems, the paper stated, and is far behind America in a number of important areas such as semiconductors, operating systems and aerospace. Within a week of its posting, the document vanished.

The circumstances around its removal are unclear. Communist Party bosses may have decided it signals weakness at a time when Xi Jinping wants to project strength—his country's, the Communist Party's and, as he prepares to be anointed president for life later this year, his own. The report's conclusions are indeed inconvenient for Mr Xi. He has been talking up "self-strengthening" against what his government calls "chokeholds" that the West exerts over access to critical technologies, from seeds to semiconductors. The power of the West to hobble its adversaries with sanctions is about to be tested in Russia, which on February 24th attacked Ukraine. China's rulers will be watching that military and economic confrontation closely because it may illuminate their own vulnerabilities. China's 14th five-year plan, a strategic blueprint published in 2021 that covers the years until 2025, makes self-reliance in science and technology a cornerstone of economic policy.

The plan's deadlines for China to break free from existing techno-dependence are fast approaching. The government is pouring billions into

the effort, and cajoling Chinese companies to do the same. Combined public and private research-and-development spending soared to a record 2.8trn yuan (\$440bn) in 2021 in a bid to catch up with foreign rivals. That is equivalent to 2.5% of GDP, still far from America's 3% or so but up from just over 2% five years ago (see chart 1). On February 11th SMIC, China's biggest chipmaker, said that it would invest some \$5bn in 2022 in new semiconductor factories. Three days later the Hong Kong unit of Standard Chartered, a British bank, became the first foreign lender outside mainland China to be directly linked to CIPS, the Chinese answer to the Belgium-based SWIFT interbank payments system.

To see how much all this adds up to, The Economist has surveyed six areas in which China's reliance on the West has been of particular concern to the party and Mr Xi. We looked at mRNA vaccines, agrochemicals, civilian aerospace, semiconductors, computer operating systems and payments networks. Our conclusions mirror those of the IISS paper: although there has been a degree of self-strengthening, self-reliance is some way off.

Chinese progress has been most pronounced in fields that, though themselves technologically sophisticated, require less extended and complex supply chains. Start with the vaccines. Much of China's progress in mRNA technology used in Western jabs such as Pfizer-BioNTech or Moderna has been linked to one man, Ying Bo. For several years Mr Ying worked on mRNA at Moderna, before returning to China from Boston at the start of the pandemic. His homecoming was hailed by state media as a patriot answering the call of the motherland. His company, Abogen Biosciences, has worked with the People's Liberation Army to develop the country's most advanced mRNA shot, and was part of a programme that has invested at least \$2.3bn in developing local vaccines.

Results from phase-one clinical trials of Abogen's jab, known as ARCoVax, were recently released, according to state media. In some ways, that looks

impressive, coming just a year and a half after the Western versions. However, the company has not made any statements about wide deployment. Annual production capacity of 200m doses looks modest next to the 4bn doses expected this year for the Pfizer-BioNTech vaccine. BioNTech offered to provide its shot to China in a partnership with Fosun, a local conglomerate, a year ago. By championing ARCOVax while denying approval to Western mRNA jabs (though not Western covid pills, one of which was approved this month), Mr Xi appears to have placed a higher value on self-reliance than on public well-being, says Huang Yanzhong of the Council on Foreign Relations (CFR), a think-tank.

Similar considerations appear to have slowed progress in agrochemical technology. Foreign genetic-modification and seed-editing methods have been banned from domestic use out of a long-held fear that this would hand foreign firms control of China's grain supply. Chinese companies have been developing home-grown alternatives; Dabeinong Biotechnology, a big feed producer, is investing heavily in research. They have also been procuring them through acquisitions. The most notable of these was the \$44bn purchase in 2016 by ChemChina, a state-controlled chemicals conglomerate, of Syngenta, a Swiss seed-and-agrochemicals giant with a granary's worth of intellectual property. But a continued lack of domestic production capacity means that China is still dependent on the import of crops. In 2021 China spent at least 400bn yuan on imports of soya, corn and cotton—much of it genetically modified (see chart 2).

Imported aeroplanes and parts cost China considerably less than that—\$19bn last year. But here, too, the party wants the industry to fly free of foreign dependencies. If state media are to be believed, it already is. This year COMAC, a state-owned aerospace group, plans to start delivering its narrow-body C919, a rival to the Boeing 737 and Airbus A320 in development since 2008. Chinese airlines have ordered hundreds of them.

On closer inspection, though, the C919 does not look all that Chinese. The programme has eaten up \$72bn or more, according to an analysis by the Centre for Strategic and International Studies, another think-tank. Yet the aircraft remains a jumble of foreign parts. Because the turbofan engines being developed for it have been mired in technical troubles, for example, the aeroplanes will for now be fitted with engines from a joint venture between France's Safran and America's GE Aviation. With hundreds of other components also produced abroad, the final product is a facsimile of a Western plane—and not exactly state-of-the-art. One Western airline-industry bigwig points out that the C919 is a generation behind Airbus's fuel-efficient A320neo, and therefore much less competitive in the global market.

China faces the same problem in trying to extricate itself from the global semiconductor supply chain, which like that for aircraft is complex and dominated by America and its allies. China's vulnerability to tech sanctions became clear in 2018, when Donald Trump's administration halted the sales of sensitive hardware that used American technology to two Chinese telecoms-equipment makers, ZTE and Huawei.

To avert anything like this happening again, the latest five-year plan stipulates that China should produce 70% of the chips it consumes by 2025, up from less than 20% last year. As in the other areas, the country is making some progress towards that goal. SMIC is planning to complete the construction of three new factories this year. The state has poured hundreds of billions of yuan into the sector. The money has helped Chinese chipmakers go on a recruiting binge. A lab in Shanghai run by Micron, an American chipmaker, has become a poaching ground for local firms. On January 26th Micron said it would close the lab altogether. The result has been to enable some big Chinese chipmakers to operate production lines cleansed of American technology, notes Adam Segal of the CFR.

| *A chip on their shoulder*

But as with airliners, the Chinese chips lag well behind the cutting edge. SMIC and others are trying to fully domesticate the supply chain for chips with structures measured in tens of nanometres (billionths of a metre), an order of magnitude bigger than the most advanced current chips. That puts them a few generations behind TSMC of Taiwan and Samsung of South Korea, the two industry leaders. China is probably years away from replicating the lithography machines built by ASML, a Dutch firm which has cornered the market for equipment to etch the tiniest integrated circuits onto silicon wafers. Shanghai Micro Electronics Equipment Group, the state company tasked with catching up with ASML, is running behind on delivering the devices, according to Tilly Zhang of GaveKal Dragonomics, a research firm. Some large investments in Chinese semiconductor capacity have gone to firms that folded or turned out to be frauds.

In the last two critical technologies China's problem has less to do with mastering a technology or recreating supply chains and more with overcoming users' lack of trust in its alternatives. The operating systems that power personal computers and smartphones are a prime example. When the Trump administration banned American firms from working with Huawei in 2019, a generation of the Chinese firm's phones were deprived not just of chips but also of Google's Android operating system. Together, these restrictions contributed to the decline of about 30% in Huawei's revenues last year.

Chinese companies are estimated to have invested \$4bn or so between 2019 and September of 2021 in the development of operating systems. Some analysts expect Huawei's Android alternative, called Harmony OS and partially based on Google's open-source system, to gain market share. But virtually all Chinese smartphones continue to run on Android and Apple's iOS, and nearly all Chinese desktops are powered by Apple's macOS or Microsoft Windows. Alternative Chinese operating systems struggle to

attract developers because they are not widely used—and they are not widely used because they do not have many apps or programs to download.

A similar chicken-and-egg problem afflicts China's effort to create a worldwide payments network. The bulk of global money transfers are processed through SWIFT, a Belgium-based interbank messaging system, and CHIPS, America's domestic clearing system. These, plus the widespread use of the dollar in international finance and trade, give America power over the global financial system. To insulate itself against the threat of eviction from the world's financial plumbing, which America has contemplated over Mr Xi's crackdown on freedom in Hong Kong and its human-rights abuses in Xinjiang, China has since 2015 been expanding a parallel system for yuan payments known as CIPS. In September the service was processing 317bn yuan in transactions each day in more than 100 jurisdictions.

The costs of CIPS's expansion are unknown but probably large. Yet gauged against the size of the Chinese economy, the system's footprint is puny. CIPS's 80 or so connected institutions are dwarfed by SWIFT's 11,000-plus. Much of the growth in the yuan's cross-border use—to 2.7% in December from 1.9% two years earlier—was the result not of foreign demand for the Chinese currency but of Chinese state firms' overseas expansion. A recent report from the Carnegie Endowment for International Peace, one more think-tank, notes that distrust of China has increased since the start of the pandemic. This does not bode well for the yuan in the short term.

Such stumbles may only strengthen the Communist Party's resolve to wean itself off the West in areas it sees as of strategic importance. Like all autarky, the technological sort will come at a cost: in billions spent, often wastefully, as well as in apps undeveloped, fields unplanted, arms unjabbed. In Mr Xi's eyes, that appears to be a price worth paying.

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科技独立运动

中国想要免受西方制裁的威胁

我们评估了它在六种关键技术上的进展

一月三十日，北京一家著名智库的网站登出了一篇研究报告，对中国正与美国进行的科技战做出了格外刺耳的评估。这篇由北京大学国际战略研究院发表的报告认为，在这两个世界大国之间科技和经济脱钩的过程中，中国很可能将是损失更大的一方。报告称，中国缺乏对核心计算系统的控制，在半导体、操作系统和航空航天等一些重要领域远远落后于美国。发布不到一周，这篇报告就不见了。

报告被撤下的原因尚不清楚。共产党的大佬们可能认为这样的观点是在示弱，而现在正是习近平要展示中国和中国共产党强大力量的时候，当然还有他自己的力量——他可是准备在今年晚些时候被任命为终身国家主席的。报告的结论对习而言确实来得不是时候，他认为西方在从种子到半导体的关键技术领域对中国“卡脖子”，所以一直宣扬要“自强”。西方通过制裁牵制对手的能力正在俄罗斯接受考验——该国于2月24日对乌克兰发动了袭击。中国领导人将密切关注西方和俄罗斯之间的军事和经济对抗，因为这可能会揭示中国自己的弱点。中国在2021年发布的战略蓝图“十四五”规划将科技自力更生作为经济政策的基石，该计划一直延续到2025年。

“十四五”勾勒的中国摆脱现有技术依赖的最后期限正在快速逼近。政府为此正在投入千亿元计的资金，同时引导中国企业也大笔投资。为了赶上外国竞争对手，2021年公共和私人研发支出总额飙升至2.8万亿元，创下新高。这相当于GDP的2.5%，与美国的3%左右还有很大的差距，但五年前这个比重还只是略微超过2%（见图表1）。2月11日，中国最大的芯片制造商中芯国际表示，将在2022年投资约50亿美元新建半导体工厂。三天后，英国渣打银行的子公司渣打香港成为中国大陆以外第一家直接接入人民币跨境支付系统（CIPS）的外资银行，CIPS相当于总部位于比利时的SWIFT银行间支付系统的中国版。

为了解这一切收效如何，本刊调查了六个领域，中共和习尤其关注中国在这些领域对西方的依赖。它们分别是mRNA疫苗、农用化学品、民用航空、半导体、计算机操作系统和支付网络。我们的结论与北京大学国际战略研究院的报告一致：尽管实现了一定程度的自强，但离自立还有差距。

在技术本身很先进，但供应链不那么长也不那么复杂的科技领域，中国的进展最为显著。先说疫苗。中国在mRNA技术（辉瑞或莫德纳等西方疫苗使用了这种技术）上的大部分进展都和一个人有关。英博在莫德纳做了几年mRNA研究，在疫情爆发之初从波士顿回到中国。中国官方媒体将他的回归誉为一名爱国者响应了祖国的召唤。他的公司艾博生物与中国人民解放军合作开发了中国最先进的mRNA疫苗，并参与了一项开发本地疫苗的计划，该计划已投入至少23亿美元。

据官方媒体报道，艾博的疫苗ARCoVax的一期临床试验结果已在近期公布。这仅比西方的mRNA疫苗晚了一年半，从某些方面来看这令人赞叹。但是，艾博尚未就大规模接种发表任何声明。辉瑞疫苗今年预计生产40亿剂，与之相比，艾博2亿剂的年产能看起来不算可观。一年前，辉瑞曾提出通过与中国企业复星医药合作向中国提供疫苗。但中国扶持ARCoVax而拒绝批准西方的mRNA疫苗（不过没有拒批西方的新冠药物，有一种已在上月获批引进），习似乎把自力更生置于了公共福祉之上，智库美国外交关系协会（Council on Foreign Relations）的黄严忠说。

类似的考量似乎也拖慢了农用化学技术的进步。长期以来，中国一直禁用外国的基因改造和种子编辑技术，担心外国公司会借此控制中国的粮食供应。中国公司一直在开发本土替代技术，大型饲料生产商大北农正在大力投资研发。中国公司也一直在通过收购获得相关技术。其中最引人注目的是2016年国有企业中国化工以440亿美元收购了拥有大量知识产权的瑞士种子和农用化学品巨头先正达（Syngenta）。但国内产能持续不足意味着中国仍要依赖农作物进口。2021年，中国花费了至少4000亿元进口大豆、玉米和棉花，其中大部分是转基因产品（见图表2）。

中国在进口飞机和零部件上花的钱要少得多，去年为190亿美元。但共产

党希望这个行业也能摆脱对外国的依赖，自由飞翔。按照官媒的说法，它已经自立了。今年，国有航空集团中国商飞计划开始交付自行研制的窄体飞机C919，这一机型于2008年开始研发，对标波音737和空客A320。中国的航空公司已订购了数百架。

然而如果仔细看的话，C919并不是那么纯粹的国货。据另一家智库战略与国际研究中心（Centre for Strategic and International Studies）分析，为研发该机型已耗资720亿美元甚至更多。但C919仍然是各种国外零部件的集合体。例如，由于为它开发的涡扇发动机技术问题层出不穷，该机型暂时将配备由法国赛峰集团（Safran）和美国GE航空（GE Aviation）的合资企业生产的发动机。再加上还有其他数百个部件也都是在国外生产，最终的产品不过是西方飞机的复制品——而且还不是最先进的那款。一位西方航空业大佬指出，C919比空客的节油型A320neo落后了一代，因此在全球市场上的竞争力要小得多。

在试图挣脱全球半导体供应链时，中国面临同样的问题。半导体的供应链和飞机的一样复杂，并且同样由美国及其盟国主导。2018年，中国面对科技制裁时的脆弱暴露无疑，当时特朗普政府禁止向两家中国电信设备制造商中兴通讯和华为销售含有美国技术的敏感硬件。

为避免这种情况再次发生，“十四五”规划要求，到2025年中国芯片自给率要达到70%——去年还只有不到20%。与在其他领域一样，中国为实现这一目标取得了一些进展。中芯国际计划今年完成三座新工厂的建设。政府已向该行业投入数千亿元。在这些钱的助力下，中国的芯片制造商开始疯狂招募人才。美国芯片制造商美光（Micron）在上海的一个实验室已成为中国公司挖角的狩猎场。1月26日，美光表示将彻底关闭该实验室。美国外交关系协会的亚当·西格尔（Adam Segal）指出，结果就是一些大型中国芯片制造商得以运营不使用美国技术的生产线。

| 耿耿于怀

但是，和飞机一样，中国的芯片技术还远远落后于尖端水平。中芯国际等公司正试图将几十纳米（一纳米等于十亿分之一米）制程的芯片的供应链

完全本地化，这种制程比当前最先进的芯片大一个数量级。这让中国公司比台积电和三星这两个行业领先者落后了几代。中国要复制出荷兰公司ASML制造的光刻机可能还需要好多年，该公司的设备可以将最微小的集成电路蚀刻到硅片上，在市场上占据垄断地位。研究公司龙洲经讯

（GaveKal Dragonomics）的蒂莉·张（音译）表示，负责追赶ASML的国有企业上海微电子装备集团推迟了设备交付。在向中国半导体产业的注资潮中，一些拿到大笔投资的公司倒闭了，还有一些后来被发现就是在骗补贴。

在最后两个关键技术领域，中国要克服的主要困难不是掌握技术或重建供应链，而是用户对它给出的替代品缺乏信任。个人电脑和智能手机的操作系统就是个典型例子。特朗普政府在2019年禁止美国公司与华为合作，华为当时的那一代手机不仅被断供芯片，还不得使用谷歌的安卓操作系统。在这些限制的联合作用下，华为去年的收入下降了约30%。

据估计，2019年到2021年9月，中国公司投入了约40亿美元开发操作系统。一些分析师预计华为用以替代安卓的鸿蒙系统将获得一定市场份额，该操作系统部分基于谷歌的开源系统。但几乎所有中国智能手机都在继续使用安卓和苹果的iOS，几乎所有中国台式电脑安装的都是苹果的mac OS或者微软的Windows。由于用户人数少，作为替代品的中国操作系统很难吸引开发者，而用户人数少又是因为这些系统没有太多可供下载的应用或程序。

这种先有鸡还是先有蛋的问题同样也困扰着中国建立全球支付网络的努力。大部分全球汇款通过总部位于比利时的银行间信息系统SWIFT和美国国内清算系统CHIPS处理。再加上国际金融和贸易广泛使用美元，美国获得了控制全球金融体系的力量。为了让自己免受被逐出全球金融网络的威胁——美国曾考虑过将中国剔除出SWIFT系统以惩罚在香港打压自由和在新疆侵犯人权的行——中国自2015年以来一直在扩大与SWIFT平行的人民币支付系统CIPS。去年9月，CIPS在100多个司法管辖区每天处理的交易达3170亿元。

扩大CIPS覆盖面的成本未知，但可能很高。然而，相对于中国的经济体量来说，这个系统的势力还微不足道。CIPS有80多家接入机构，远远比不上SWIFT的1.1万多家。两年前，人民币在跨境支付中的占比为1.9%，去年12月上升到2.7%，大部分增长不是因为外国对人民币的需求增加，而是因为中国国有企业在海外的扩张。智库卡内基国际和平基金会（Carnegie Endowment for International Peace）最近的一份报告指出，自疫情开始以来，对中国的不信任有所增加。这在短期内对人民币来说不是好兆头。

这样的挫折也许只会让共产党更加坚定决心，要在它认为具有战略重要性的领域摆脱对西方的依赖。和所有自给自足的政策一样，科技自立也要付出代价：巨额的投入（常常都很浪费）、没开发的应用、没播种的农田、没接种疫苗的人群。但在习眼里，这样的代价似乎是值得的。





Climate change

The latest UN climate report is gloomy, with some sunny patches

It says that adaptation is as important as prevention

THERE IS A peculiarly modern form of the uncanny which Glenn Albrecht, a philosopher, dubs “solastalgia”. It is an uneasy feeling that what you took to be the natural way of things has been changed, without your consent, and that your life does not fit into it as once it did. It is the sort of feeling you might expect if, say, what used to be an unusually wet year was now merely typical. It might be dismissed as the “new normal”. But it does not feel normal, and it never will. Before you get used to it, it will have changed yet again.

The vast new overview of the impacts of global warming published by the Intergovernmental Panel on Climate Change (IPCC) on February 28th paints a picture of a planet where solastalgia is the norm. Half a billion people, it says, most of them in medium or high latitudes, live in places where the average year is now wetter than wet years were in the 20th century. In low latitudes, by contrast, there are 160m people living where the reverse is true.

These “unfamiliar” climates, as the report calls them, do not merely generate unease. Shifts in averages bring with them large changes in the likelihood of extreme events—and those can do great harm, especially to people already vulnerable as a result of poverty, of political or social exclusion, of an already degraded environment that is the material basis of their livelihoods, or of all of the above and more besides. The report is not just a diagnosis of malaise. It is, in the words of Antonio Guterres, the UN secretary-general, an atlas of human suffering.

The IPCC notes that there have been increases in extreme high

temperatures, both on land and in the seas; in torrential rain; in droughts; and in weather conducive to wildfires. And these have reliably hit the vulnerable more than the rest of the world. In the 2010s mortality caused by floods, droughts and storms was 15 times greater in highly vulnerable regions than in the least vulnerable.

Climate change is contributing to humanitarian crises which see vulnerable people displaced in all parts of the world. Instances of food insecurity and malnutrition that can be blamed on droughts and floods have increased in Africa and Latin America. Contrary to some analysis, though, the report does not see much of a climate influence on violent conflict.

| *Adept adaptations*

Adaptation can cope with some of this, and in places, the report finds, it has already made a difference. One example is Ahmedabad, a city in Gujarat, in western India, which the report praises for pioneering “preparedness for extreme temperatures and heatwaves” by adopting an early warning system (the first in South Asia) and changing building regulations to stop the trapping of heat, among several other measures. Another instance is the use of sand dams in Kenya. These increase storage of groundwater in riverbanks by up to 40%, thus helping people weather droughts. But there is increasing evidence of what the IPCC calls an “adaptation gap”. As the climate has worsened, the distance between adaptations actually being undertaken and those which are needed has widened. And it looks set to widen further.

In the near term, trying to narrow this widening gap is a crucial task. Adaptation often takes second place to prevention in discussions about climate change, and it is true that, because total greenhouse-gas emissions are the long-term determinant of such change, dramatically reducing emissions takes logical precedence over all other responses to the crisis.

But the IPCC argues that, over the coming decades, the difference between worlds with better and worse adaptation is greater than between worlds with more or fewer emissions. That alone should give efforts to adapt to a changing climate a new urgency.

| *Three into one does go*

In 1988, when the IPCC was set up, it was charged by the relevant UN bodies with assessing what was known for sure about climate change, in order to provide a basis for discussions on which all could agree. It split that task into three parts: the physical science of climate change; the impacts of climate change on the human and natural world; and the possible responses. Each was parcelled out to a working group of researchers. The resulting report was crucial to the negotiation of the UN Framework Convention on Climate Change (UNFCCC), in 1992, and immediately spurred calls for a second assessment. The assessing has been progressing ever since, with more and more researchers involved in producing reports that have grown steadily larger and less frequent.

Having delivered its fifth assessment report in 2014, the panel is now in the throes of releasing the three tranches of the sixth. The tranche on the physical science came out last August. April will see the one on research into the mitigation of climate change. The 3,700 pages (a browser-freezing 280 megabytes) released on February 28th are an account of the state of play regarding impacts, vulnerabilities and adaptation.

The impacts of the warming which has raised the global mean temperature 1.1-1.3°C above its pre-industrial value can be seen around the world. They affect people, the things they grow for food and fabric, and the rest of the living world. The report documents widespread shifts in the timing of the seasons and notes that half of the species scientists have looked at in this context are moving towards higher latitudes, higher altitudes or both, to cool down (though it does admit there may be some sampling bias here).

Plants people eat are also under stress. Increases in agricultural productivity over the past 50 years are significantly lower than they would have been in the absence of climate change, the report notes with moderate confidence. (After problems with earlier assessments, almost all the judgments in the sixth come complete with confidence estimates, which can range from low to very high.)

Some natural systems are approaching or surpassing their capacity to adapt. Coral reefs, rainforests, coastal wetlands and polar and mountainous ecosystems are all butting up against “hard limits”. For example, at 1.5°C of warming the report expects the number of terrestrial and freshwater species at very high risk of extinction may be as great as 14%.

Human systems, too, may prove to have hard limits. There are combinations of heat and humidity that make unprotected outdoor life impossible. At 100% humidity, people cannot survive above 35°C because they cannot cool down by sweating. In the nearer term, though, what the report calls “soft limits” matter more.

Heatwaves in the northern hemisphere last summer illustrate the point. British Columbia recorded a freakishly high temperature of 49.6°C. Almost simultaneously, Iraqis protested against electricity cuts as temperatures in their country exceeded 50°C. The Canadian heatwave was more unusual than the one in Iraq. And Canada has the resources to prepare for another, if it so chooses. Iraq does not. It is up against its soft limits—hence the protests.

Soft limits can be overcome, but not easily. In Iraq’s case, that would require simultaneously overhauling the attitudes and capacity of the government, reforming institutions, and getting groups of donors to provide new money to support all this.

That sort of transformational change remains rare. But efforts to adapt have nevertheless increased in number and ambition. As a consequence, enough experience is now available for the assessment to look, for the first time, at how well the world is doing, as well as at how much it needs to do. The findings are mixed.

Planning for adaptation is now widespread. Implementation, sadly but predictably, rather less so. Some programmes now in place have brought additional benefits beyond their alleviation of climate risk. The restoration of mangrove forests along coasts—which Indonesia, home to more than a fifth of the world’s mangroves, is currently trying to pursue—not only sequesters carbon and helps protect against sea-level rise and erosion. It also boosts fish stocks, balances concentrations of nutrients, and attracts tourists and, thus, money.

The report does, however, raise worries about the quality of some adaptation efforts. Actions to lower immediate risks, it argues, can reduce opportunities for the transformational adaptation it sees as crucial to improving things over the longer term. It warns of risks from “maladaptation”, in which efforts to deal with the impacts of climate change do more harm than good. One example would be building a sea wall around a city. Doing so protects the residents from rising sea levels and storm surges in the short term. But it can change the pattern of currents by the coast, creating worse erosion elsewhere.

| *Actions and words*

Such measures may also create a false sense of security. In the floodplain around the Jamuna river in Bangladesh there is evidence that the presence of levees attracts more people to live there, increasing the number of deaths that would result were a levee to break. Starting an irrigation system in an area where rain can no longer be relied on to grow crops could lead to overconsumption of river water, leaving people downstream with less. “In

choosing the right solutions, we need to be thinking about more than just one climate hazard and also about the range of side-effects of the interventions we undertake,” says Maarten van Aalst, director of the Red Cross Red Crescent Climate Centre, and one of the report’s authors.

The fact that tangible damage is already here adds not just physical burdens but also political ones. Negotiation at the meetings of UNFCCC, most recently in Glasgow last November, becomes particularly heated over what the convention calls “loss and damage”—impacts which have already been felt, and over which poor countries have a case for compensation.

Reportedly, the biggest ructions in the closed plenary in which the wording of the “summary for policymakers” was hashed out between the authors and the representatives of governments signed up to the process stemmed from attempts by some of those governments to ensure that it did not do too much to bolster the poor countries’ case. Politics is hardly a new addition to the IPCC. It was, after all, created in part to generate political “buy in” to scientists’ warnings. But from here on, with assessment a matter of the present, not the future, expect the tensions to grow. ■



气候变化

最新的联合国气候报告乌云密布，有少许阳光

报告称适应和预防同样重要

有一种现代怪症，哲学家格伦·阿尔布雷希特（Glenn Albrecht）称之为“乡痛症”。这是一种不安的感觉，懵然之间，曾经熟悉的一切都发生了改变，你的生活无法像过去那样融入周遭。这种感觉就好像以前偶尔会有一年降雨特别多，而现在却年年如此。你也许可以轻描淡写地说它是“新常态”。但感觉又不正常，而且永远不会感觉正常。还没等你完全适应这个变化，新的变化就又来了。

2月28日，政府间气候变化专门委员会（以下简称IPCC）发布了有关全球变暖的影响的新报告。在这份超大型综合报告的描绘中，乡痛症是这个世界的常态。报告称，在全球50亿人所生活的地区（大多是中高纬度地区），如今的平均年降水量高于20世纪降雨量高的年份。而在有1.6亿人生活的低纬度地区，情况正相反。

这些被报告描述为“陌生”的气候引发的不仅是不安。气候均值的变化会造成发生极端天气事件的可能性大幅变化，而这些事件可能会造成重大损害，尤其会冲击那些本就因各种因素而很脆弱的人群，这些因素包括贫困、政治或社会排斥、赖以生存的环境不断退化，或以上全部甚至更多因素的叠加。该报告不仅是对气候问题的诊断。用联合国秘书长安东尼奥·古特雷斯的话来说，它还是一份人类苦难的地图集。

IPCC指出，不管在陆地还是在海上，极端高温、暴雨、干旱、以及容易引发山火的天气都有增加。它们也确实最沉重地冲击了脆弱人群。在21世纪的第二个十年里，洪水、干旱和暴风雨在高脆弱度地区造成的死亡人数是脆弱度最低地区的15倍。

气候变化正在加剧人道主义危机：世界各地有大批脆弱人群流离失所。在非洲和拉丁美洲，由于干旱和洪水导致的粮食无保障和营养不良事件增加

了。不过与一些分析结果相反的是，该报告并没有发现气候变化对暴力冲突有什么影响。

| 灵活适应

适应可以应对其中一些问题。报告发现，在有些地方它已经带来了不同。印度西部古吉拉特邦（Gujarat）的艾哈迈达巴德市（Ahmedabad）就是一个例子。IPCC报告称赞该市开创性地采取多项“准备措施以应对极端高温和热浪”，例如采用预警系统（为南亚首个）和修改建筑法规以减少热量聚集。另一个例子是肯尼亚的沙坝。运用沙坝可以将河岸的地下水储存量增加40%，帮助人们捱过早情。但现在有越来越多的证据显示存在IPCC所说的“适应差距”。随着气候的恶化，在实际采取的适应措施与所需要的措施之间，差距已经扩大。而且看起来这种差距必将进一步扩大。

短期内，努力缩小这一不断扩大的差距是一项至关重要的任务。在有关气候变化的讨论中，适应往往排在预防之后。由于温室气体排放总量确实是气候变化的长期决定因素，因此大幅减排要优先于其他危机应对措施在逻辑上是对的。但IPCC认为，在接下来的几十年里，适应能力好坏对世界的影响要大于排放量多少的影响。仅此一点就应该让适应气候变化的努力成为一项新的紧要任务。

| 三合一大而全

1988年IPCC成立时，联合国相关机构让它负责评估确切的气候变化情况，以便提供一个各方都认同的讨论基础。它将这项任务分为三个部分：气候变化的自然科学、气候变化对人类和自然界的影 响，以及可能的应对措施。每部分任务各分给一个工作组。由此得出的报告对1992年《联合国气候变化框架公约》（UNFCCC）的谈判至关重要，并立即引发了开展第二次评估的呼声。从那以后，评估一直在取得进展，越来越多的研究人员参与进来，发布的报告越来越长，发布频率越来越低。

IPCC在2014年发布了第五次评估报告，现在正忙于准备发布第六次报告三个部分。自然科学部分已于去年8月发布。关于如何减缓气候变化的研究报告将在4月发布。2月28日发布的报告长达3700页（有280MB之大，能

让浏览器都卡住），描述了影响、脆弱性和适应的现状。

全球变暖已导致全球平均温度比工业化前水平高出 1.1°C 至 1.3°C ，其影响在世界各地随处可见。人类、人类为获得食物和布料而种植的作物、以及世界上其他所有生物都无一幸免。该报告记录了季节变迁的广泛变化，并指出科学家在这种情况下研究过的物种中，有一半为了寻找更清凉的生存环境，正在向更高纬度、更高海拔或两者兼具的地方迁徙（尽管报告确实承认可能存在一些抽样偏差）。

人们食用的植物也在承压。报告以中等置信度指出，过去50年里，农业生产率的提升幅度要明显低于假如没有气候变化的提升水平。（在前几次评估出现可信度问题后，第六次报告中几乎所有判断都带有置信度估计，从低到很高。）

一些自然系统正在接近或超过其适应能力上限。珊瑚礁、热带雨林、沿海湿地以及极地和山地生态系统都撞上了“硬限制”。例如，该报告预计，在升温 1.5°C 时，面临极高灭绝风险的陆地和淡水物种可能占到14%。

人类的身体也可能碰到硬限制。在既高温又高湿的情况下，如果不做防护，将无法进行户外活动。在湿度达到100%时，人们无法在 35°C 以上的温度下生存，因为无法通过排汗降温。不过，在近期内，报告所称的“软限制”更为紧要。

去年夏天北半球的热浪就是个例子。不列颠哥伦比亚省出现了 49.6°C 的异常高温。几乎在同一时间，伊拉克的气温超过了 50°C ，热浪中的停电引发了民众抗议。加拿大的热浪比伊拉克的更不寻常。而只要加拿大愿意，它有充足的资源为下一次热浪做准备。伊拉克可没有。它触碰到了软限制——也因此会发生抗议。

软限制可以克服，但并非易事。对伊拉克而言，这需要同时彻底改变政府的态度和能力，改革机构和制度，并让捐助团体另外提供资金来支持这一切。

这种转型性变革依然很少见。不过，为适应做出的努力已经越来越多，也越来越富有雄心。因此，现在已有足够的经验，让这次评估可以首次了解全球的适应现状，以及还需要付出多少努力。评估的结果好坏参半。

适应气候变化的计划现在很普遍。可悲但又可以预见的是，真正付诸实施的要少得多。除了减轻气候风险之外，正在实施的一些计划还带来了额外的好处。沿海红树林的恢复不仅可以固碳，还有助于防止海平面上升和海岸线后退。印度尼西亚目前正在努力恢复其占世界五分之一以上的红树林。红树林还会增加鱼类资源，平衡营养物质的浓度，吸引游客，钱也就随之而来。

然而，该报告确实引发了对于一些适应措施的质量的担忧。报告指出，降低眼前风险的适应行动可能会减少转型性适应的机会，而报告认为这样的机会对更长期改善事态至关重要。报告警告可能会出现“适应不良”，即应对气候变化影响的努力弊大于利。在城市周围建造海堤就是这样一个例子。这样做能在短期内保护居民免受海平面上升和风暴潮的影响，但海堤可能会改变沿岸的洋流模式，在其他地方对海岸造成更严重的侵蚀。

| 行与言

此类措施还可能造成虚假的安全感。有证据表明，在孟加拉国贾木纳河（Jamuna）沿岸的洪泛区，堤坝的存在吸引了更多人在那里生活，也就增加了可能因堤坝溃决而死亡的人数。在一个无法再依赖降雨种植农作物的地方启用灌溉系统可能会过度消耗河水，从而导致下游居民供水不足。“在选择正确的解决方案时，我们需要考虑的不仅仅是一种气候危害，还要考虑我们采取的干预措施有多大的副作用。”红十字会与红新月会气候中心（Red Cross Red Crescent Climate Centre）的主任马尔滕·范阿尔斯特（Maarten van Aalst）说，他是报告的作者之一。

有形的损害已经存在，这个事实不仅增加了实际负担，也加重了政治负担。在历次联合国气候大会上（最近一次会议于去年11月在格拉斯哥举行），围绕《公约》所称的“损失和损害”问题的谈判特别激烈。“损失和损害”是指已经感受到的影响，贫穷国家有理由就此要求赔偿。

在全体闭门会议上，报告作者和参与讨论的政府代表之间就《决策者摘要》的措辞进行了大量讨论之后定稿，据报道，其中最大的争议就源于一些政府试图确保《摘要》不会给穷国索赔提供太多支持。政治在IPCC算不上新鲜事。毕竟，创建IPCC的原因之一就是为了让科学家的警告在政治上被“买账”。但从现在开始，随着评估注重当下，而不是未来，等着看争议升温吧。■



A lopsided romance

Despite thriving trade, China's relationship with Brazil is weakening

President Jair Bolsonaro's rhetoric has not helped

ON A TRIP to China in 2004 Luiz Inácio Lula da Silva, then president of Brazil, took with him an entourage fit for a rock star: seven cabinet ministers, six state governors and more than 450 businessmen. Relationships were established and deals hashed out. Over the next five years China would become Brazil's most important economic partner. By 2019 annual trade between the countries was worth \$100bn.

The first state visit by Jair Bolsonaro, the current president, was far more muted. Mr Bolsonaro had spent much of his time on the campaign trail in 2018 railing against China, which he accused of wanting to “buy Brazil”. When he visited in 2019 he brought along four ministers, but no senior economic advisers. Although he spoke of how the countries were “completely aligned”, the trip was overshadowed by talk of whether or not he would allow Huawei, a Chinese telecoms firm, to build some of the 5G network in Brazil.

The relationship between Brazil and China has never been straightforward, but under Mr Bolsonaro it has never been worse. Despite his talk of alignment in 2019, he has continued to take swipes at China, as have members of his family, several of whom are in politics. Early in the pandemic his son, Eduardo, spoke of the “China virus”. Last year, without naming China, the president mused that covid-19 could be “chemical warfare”. China, for its part, may be keen to trade with Brazil, but it is increasingly wary of investing in the country—and in the rest of Latin America.

Mr Bolsonaro's antagonism has not gone unnoticed by Chinese officials. In

2020 Li Yang, China's consul general in Rio de Janeiro, wrote a comment piece for O Globo, a newspaper, in which he responded to Eduardo's comments with unusual ferocity. The boss of Sinovac Biotech, a Chinese firm which provided covid vaccines to Brazil, was quoted by Reuters as telling diplomats that the president's remarks were preventing a "fluid and positive" relationship between the two countries.

Sometimes China likes to remind Brazil of its power. Late last year Brazilian beef exports took a hit when China imposed a three-month ban on them after two cases of atypical mad-cow disease were found in different states. The value of beef exports slumped; the ban cost around \$2bn in sales. Many thought the embargo was unusually long.

The row over beef notwithstanding, trade between Brazil and China has flourished, even through the pandemic. In 2021 China bought over 30% of Brazil's physical exports, up from less than 20% five years earlier. Most of this was soyabeans, crude oil and iron ore, but shipments of meat and other higher-value goods have also grown in recent years, particularly since the trade war between the United States and China took off in 2017 (see chart 1).

| *Beefs with Bolsonaro*

But other economic ties between Brazil and China appear to be weakening. China's investment in Brazil peaked in 2010, according to the China-Brazil Business Council (CEBC) (see chart 2). In that year China invested \$13bn in 12 projects. The CEBC estimates that last year it invested only around \$4bn.

This hints at a wider trend. Although the presidents of Argentina and Ecuador recently went to Beijing in order to boost economic ties with China, economic agreements between China and Latin America have waned in recent years. In an address to the Community of Latin American and Caribbean States (CELAC), a regional organisation, in 2015, Xi Jinping, China's president, pledged \$250bn in investment in Latin America by 2025.

But between 2015 and 2020 Chinese firms invested only \$76bn in the region, according to researchers at Boston University. In December, at another meeting with CELAC, Mr Xi did not pledge any further investment. (Brazil did not attend, as Mr Bolsonaro had pulled out of CELAC in 2020.)

Brazil, in particular, makes foreign investment hard. The country's rules and regulations are prodigious and ever-changing. Its currency, the real, is volatile; its labour laws are complicated and its tax system badly needs reform. Corruption and uncertainty over economic policy do not help. "If a Chinese company can survive in Brazil, it can do so anywhere," says Qu Yuhui, a Chinese diplomat who was based in Brazil until recently.

Chinese investors focus on what they perceive as safe bets. Nearly half of the money they put into Brazil before 2020 went into electricity generation, which has the benefit of long-term contracts. Several Chinese power firms have established themselves in the country. Brazil benefits from Chinese expertise: both countries have ultra-high-voltage transmission lines that stretch thousands of kilometres.

The power industry, though, also generates challenges. Last year the CEO of State Grid Brazil, a subsidiary of one of the biggest Chinese state-owned electricity firms, described the difficulty of acquiring land for a huge transmission line between the Belo Monte dam in Pará, in the north, and the consumers of south-eastern Brazil. The effort involved negotiating individually with "3,337 property owners" and obtaining "204 inter-regional licences, including [for] rivers, lines, highways, railways, oil ducts, small airports, etc".

Brazil ought to be doing more to lure foreign investment, yet its efforts tend to be sporadic, driven more by state-level politicians than by the federal government. The state of São Paulo, for example, set up a trade office in Shanghai in 2019. João Doria, the governor of São Paulo, credits it with

helping him strike a deal with Sinovac for covid vaccines. But few Brazilian companies have set up offices in China, or even ventured to visit, says Tatiana Lacerda Prazeres, a trade consultant in China, and a former foreign-trade secretary of Brazil. “There is a perception among some top Brazilian officials, and even some businesses, that China is more dependent on Brazil than vice versa,” she says.

China’s large appetite for Brazilian commodities reinforces that attitude. But the view from China is quite different. Compared with other regions, Latin America has always been China’s “lowest priority”, in terms of diplomacy and investment, says Margaret Myers of the Inter-American Dialogue, an American think-tank. Asia and Africa remain more important.

Moreover, China’s appetites may be changing. Its drive towards “basic self-sufficiency” in grain, as laid out in its latest five-year-plan, includes an effort to boost soyabean production. Scepticism about the plan abounds. But even a small decrease in Chinese purchases would hurt Brazil, which sends 70% of its soyabean exports to China. If demand for new housing in Chinese cities were to drop, as some predict, that would diminish demand for Brazilian iron ore and other raw materials. (Though a slowdown in construction at home might also push Chinese infrastructure firms to seek opportunities abroad.)

Brazil’s presidential election in October will help determine the future of the relationship. Lula is mulling a run. He tops Mr Bolsonaro by a wide margin in most polls. If he were to become president again, there is little doubt that he would try to mend ties. Wooing Chinese investors, though, may be harder the second time around. ■



失衡的罗曼史

尽管贸易繁荣，中国与巴西的联系却在减弱

巴西总统博索纳罗的言辞火上浇油

前巴西总统卢拉2004年到访中国时，随行阵容之庞大堪比摇滚巨星：七名内阁部长、六名州长，450多名企业家。两国加强了关系，敲定了交易。之后五年里，中国成为巴西最重要的经济伙伴。到2019年，两国之间的年贸易额达到1000亿美元。

现任总统博索纳罗的首次对华国事访问要低调得多。2018年竞选期间，他花了不少时间抨击中国，指责中国想要“买下巴西”。2019年访华时他带上了四位部长，没带高级经济顾问。尽管他谈到两国如何“完全一致”，但当时关于他是否会允许中国电信公司华为在巴西建设部分5G网络的传言不断，给这次访问蒙上了一层阴影。

巴西和中国的关系从来就不简单，但在博索纳罗治下前所未有地糟糕。尽管在2019年谈到了双方的一致，但他继续抨击中国，他的家人也是如此——其中有几位是政界人士。在疫情爆发初期，他的儿子爱德华多谈论“中国病毒”。去年，虽然没有点名中国，但博索纳罗意有所指地称新冠肺炎可能是一场“化学战”。中国方面可能热衷于和巴西开展贸易，但在投资巴西以及拉美其他国家方面日益谨慎。

中国官员自然注意到了博索纳罗的敌意。2020年，中国驻里约热内卢总领事李杨为《环球报》（O Globo）撰写了一篇评论文章，以不同寻常的激烈态度回应了爱德华多的言论。据路透社报道，向巴西提供新冠疫苗的中国企业科兴制药的老板对外交官们表示，巴西总统的言论阻碍了两国间“顺畅积极”的关系。

有时候，中国喜欢提醒一下巴西记得中国的影响力。去年下半年，在巴西不同的州发现了两例非典型疯牛病病例后，中国对巴西牛肉实施了为期三个月的进口禁令，巴西牛肉出口因而受到打击。牛肉出口额暴跌，禁令造

成了约20亿美元的销售额损失。许多人认为禁运时间长得不同寻常。

尽管在牛肉上有些纷争，但中巴贸易仍然红火，甚至在疫情期间也是如此。2021年，中国购买了巴西30%以上的出口货物，五年前这一比例不到20%。其中大部分是大豆、原油和铁矿石，但近年来肉类和其他高价值商品的出货量也有增长，尤其是自2017年中美贸易战爆发以来（见图表1）。

| 和博索纳罗的过节

但巴西和中国之间的其他经济联系似乎正在减弱。根据中国-巴西企业家委员会（CEBC）的数据，中国对巴西的投资在2010年达到顶峰（见图表2）。那一年，中国在12个项目上投资了130亿美元。CEBC估计，中国去年对巴西的投资仅在40亿美元左右。

这透露出一个更广泛的趋势。尽管为加强与中国经济联系，阿根廷总统和厄瓜多尔总统最近到访了北京，但中国和拉丁美洲之间的经济协议近年来有所缩减。2015年，中国国家主席习近平在向区域组织拉丁美洲和加勒比国家共同体论坛（CELAC）致辞时，承诺到2025年向拉美投资2500亿美元。但据波士顿大学的研究人员统计，2015年至2020年期间，中国企业在该地区的投资仅为760亿美元。去年12月，在CELAC的另一次会议上，习近平没有承诺任何进一步的投资。（巴西没有参加，因为博索纳罗在2020年退出了CELAC。）

在巴西，外国投资尤其困难。这个国家的规章制度数不胜数，且永远在变。它的货币雷亚尔波动频繁；它的劳工法非常复杂，税收系统又亟需改革。腐败和经济政策的不确定性更是雪上加霜。“如果一家中国企业在巴西能存活，那它在哪儿都能活。”不久前才离开巴西的中国外交官瞿瑜辉表示。

中国投资者专注于他们认为安全的押注。2020年之前，他们在巴西将近一半的投资都投到了发电上，这类项目的好处是有长期合同。几家中国电力公司已经在巴西站稳了脚跟。巴西受益于中国的专业技术，因为两国都有

数千乃至上万公里长的超高压输电线路。

不过电力行业也有挑战。去年国家电网巴西公司（中国最大的国有电力公司之一的子公司）的CEO描述了在建设连接巴西北部帕拉（Pará）的贝罗蒙特大坝（Belo Monte）和巴西东南部的消费者之间的大型输电线路时，要获取土地困难重重。这包括要跟“3337名业主”挨个谈判，并且要拿到“204个跨区许可证，覆盖河流、管线、公路、铁路、输油管道、小型机场等”。

巴西应该在吸引外国投资方面多做些事，但它的努力往往是零散的，更多是由州一级的政客而不是联邦政府推动。例如，圣保罗州2019年在上海设立了一个贸易办事处。该州州长若昂·多利亚（João Doria）称，正因为有了这个办事处，他才和科兴制药达成了购买新冠疫苗的协议。但是，驻中国贸易顾问、巴西前对外贸易部长塔蒂亚娜·拉塞尔达·普拉泽雷斯（Tatiana Lacerda Prazeres）说，很少有巴西公司在中国设立办事处，它们甚至都不曾来过中国。“巴西一些高级官员，甚至一些企业，都有一种看法，认为是中国更依赖巴西，而不是反过来。”

中国对巴西大宗商品的巨大需求强化了这种观点。但中国方面的看法却截然不同。美国智库美洲对话（Inter-American Dialogue）的玛格丽特·迈尔斯（Margaret Myers）表示，与其他地区相比，在外交和投资方面，拉美对中国来说一直都是“最不紧要的”。亚洲和非洲仍然更为重要。

此外，中国的需求可能正在变化。最新的五年规划里，中国提出要实现谷物“基本自给”，其中包括努力提高大豆产量。对这一计划持怀疑态度的人很多。但即使中国的购买量只是小幅下降也会冲击巴西，因为巴西70%的大豆都出口到中国。如果真像一些人预测的那样，中国城市新建住宅需求下降，那么对巴西铁矿石和其他原材料的需求就会减少。（尽管国内建设放缓也可能会促使中国基础设施企业到海外寻找机会。）

巴西10月的总统大选有助于决定两国关系的未来。卢拉正在考虑参选。在大多数民调中，他都大幅领先博索纳罗。如果卢拉再次当选总统，毫无疑

问他会努力修复两国关系。不过，这一次要争取中国投资者可能更难了。





Chasing the dragon

How Chinese firms have dominated African infrastructure

Western firms grumble more but compete less

WHEN IT COMES to building big things in Africa, China is unrivalled. Beijing-backed firms have redrawn the continent's transport map. Thanks to China's engineers and bankers you can hop on a train in Lagos to beat the traffic to Ibadan, drive across parts of eastern Congo in hours rather than days or fly into any one of dozens of recently spruced-up airports from Zanzibar to Zambia. Throw in everything else from skyscrapers and bridges to dams and three dozen-odd ports and it all adds up to rather a lot of mortar.

It was not always so. In 1990 American and European companies scooped up more than 85% of construction contracts on the continent. Chinese firms did not even get a mention. Now Western firms are struggling to win business in a fast-growing market. (The World Bank predicts that demand for infrastructure spending alone will be more than \$300bn a year by 2040.) Africa's population is growing faster than that of any other continent, and Africans are moving to cities faster than people elsewhere. Both these trends will drive demand. The dragon's share will be built by Chinese firms, which in 2020 were responsible for 31% of all infrastructure projects in Africa with a value of \$50m or more, according to Deloitte, a consultancy. That was up from 12% in 2013. Western firms were directly responsible for just 12% or so (compared with 37% in 2013).

This remarkable turn of fortune for Western firms worries not only their shareholders but also their governments, which see China's growing economic might in Africa as strengthening its strategic and diplomatic clout. Its Belt and Road Initiative (BRI) finances ports, roads and other infrastructure, which makes Western generals anxious that China may

open another naval base in Africa (it has one in Djibouti). Western governments also worry that Chinese investments in African mines will give it a stranglehold over strategic minerals, such as the cobalt used in electric cars. Of late America has put competing with China at the core of its foreign policy. It and Europe have been trying to offer African countries financing alternatives to the BRI. At an EU-Africa summit on February 17th, European leaders outlined plans to pour €150bn (\$170bn) into African infrastructure.

Western governments are also trying to herd their companies into investing more and building more in Africa. This is easier said than done. Some Western construction firms grumble that the odds are skewed against them from the outset, not least because China is such a big spender. Between 2007 and 2020 Chinese development banks provided \$23bn for African infrastructure, compared with \$9.1bn from all other development banks, according to the Centre for Global Development, a think-tank in Washington (see chart).

Chinese lenders are pluckier than their Western rivals. Sometimes this borders on recklessness. When Uhuru Kenyatta, Kenya's president, wanted \$4.7bn to build a new railway which the World Bank warned would never turn a profit, Chinese lenders backed it. The railway has since lost more than \$200m. Often, Chinese firms are tough negotiators. Several have struck resources-for-roads deals, such as those worth more than \$1.1bn in Ghana and Guinea, where the loans are backed by bauxite. A study by AidData, part of William & Mary university, found that Chinese lenders routinely impose unusually tough conditions to ensure they are repaid.

Western firms also complain that their own governments offer fewer sweeteners. Last year China said it would stump up its own cash to build smart new foreign ministries in Congo and Kenya. It has also picked up the tab for numerous other official buildings, from parliament complexes in

Sierra Leone and Zimbabwe to presidential palaces in Burundi, Guinea-Bissau and Togo. Given such generosity, it is hardly surprising that some African governments are predisposed to favour Chinese firms. Western governments, by contrast, often spend aid on unglamorous and sometimes unpopular things like educating girls.

Most significantly, perhaps, Chinese firms have a reputation for building swiftly. Finance from Chinese development banks is quickly forthcoming, and some projects in Africa seem to be replicas of ones built in China, which presumably saves time on drawing up plans. (Stations along the new Chinese-built railway between Ethiopia and Djibouti, for example, look as if they were plucked from the Asian plain). Some of this speed may also come from cutting corners on things like environmental-impact assessments.

As a result, Chinese firms can usually deliver a big project within a single election cycle, thereby handing incumbent leaders a ribbon-cutting photo opportunity shortly before their people vote. Western firms are rarely as nimble. “It is hard for us to get up to the starting line,” says an executive at a European engineering firm.

Chinese firms often win contracts for the simple reason that they are more competitive, according to a study by Brookings, an American think-tank, of international projects financed by the World Bank. Western firms grouse that some of the Chinese projects are shoddily built, and stories abound of roads that crumble after a few years. But another study of infrastructure projects funded by the World Bank, this time by the China-Africa Research Initiative at Johns Hopkins University, found no difference in the quality of work done by Chinese contractors and Western ones. The World Bank is, however, a stickler for clean bidding and high construction standards, so firms bidding on projects it funds may be on their best behaviour.

And in many cases Chinese firms are scooping up work because they have

no competition—many Western firms stay away because they think Africa is too risky. It can, indeed, be hazardous. Property rights are frequently threadbare; fraud abounds. One Western manager describes trying to buy land only to discover, belatedly, that the people his consortium were negotiating with did not actually own it.

Such difficulties help explain why many infrastructure projects flop before the first brick is laid. McKinsey, another consultancy, calculates that 80% of infrastructure projects in Africa never make it beyond the planning stages and only one in ten achieves financial closure.

Another huge deterrent is corruption. In the past Western firms often greased palms to win work in Africa—and elsewhere. A survey of more than 4,000 firms in 1999-2000 found that construction firms spent 1-2% of revenue on bribes, according to a World Bank paper by Charles Kenny. He also noted that in 2005 fully 40% of international construction firms said they had lost a contract in the previous year because a competitor had paid a bribe.

Nowadays anti-corruption laws in America and Britain are tougher, and are applied regardless of where the bribery occurs. Western firms are therefore more reluctant to pay bribes, though some still land in hot water. For example, Halliburton, an American firm, was fined in 2017 for violations in Angola and the World Bank has imposed sanctions on a subsidiary of Bouygues, a French construction firm, over irregularities on contracts.

Yet, grumbles a Western project manager, some officials in Africa are unmoved by these anti-corruption laws and still ask: “But where are the brown envelopes for the ministers? Where are the brown envelopes for the permanent secretaries?” The head of a Western mining company complains that his hands are tied in comparison with Chinese firms, which are able to operate without licences or even, in rebel-infested places such as the

Central African Republic, the permission of the government, if they have paid off local warlords instead.

Some Western firms still try to compete for business. Not all have happy experiences. In 2017 Bechtel, a big American construction firm, won a \$2.7bn contract to build what would have been Kenya's biggest-ever road project. Having agreed to pay up front for the road, the Kenyan government changed its mind and asked for a loan instead. When the American government declined, Kenya cooled on the idea.

A British company, GBM Engineering, secured by default a \$2bn contract to build Kenya's largest dam after five Chinese rivals, apparently unfamiliar with the idea of a competitive tender, failed to submit their bids on time. Six months later GBM's contract was cancelled amid allegations of Chinese pressure on the government board that awarded the tender. GBM won five appeals. All were blithely ignored. The case continues to meander through the courts and the dam, like Bechtel's highway, remains unbuilt.

Not every Western executive is crying into a cold beer at the local Sheraton, however. An increasing number of French firms are collaborating with Chinese entities, notes Thierry Pairault of the School for Advanced Studies in the Social Sciences, in Paris. At first relationships were informal, with French and Chinese firms working separately on the same project, often with the former doing the more complex parts.

More recently Franco-Chinese co-operation has become more formal. CMA CGM, a French logistics giant, has gone into partnerships with firms such as the China Harbour Engineering Company. In some cases French firms want Chinese partners because they can bring state-backed finance that is not on offer in Paris. But in other cases a formal collaboration emerges after years of working together informally. Deloitte found that in 2020 no less than 15% of all big infrastructure projects were being built by consortia,

including those composed of Western and Chinese firms.

China's involvement in African infrastructure has not been an unalloyed good. In some cases it has left countries drowning in debt, fuelled domestic corruption or produced infrastructure that, like Kenya's railway, will never turn a profit. But long after the scandals have faded—and debts have been defaulted on—China's legacy will be the roads and ports that Africa so badly needs for economic growth.

Perhaps as important is that China is unwittingly crowding in Western money by stoking the geopolitical anxieties of Western leaders. Britain's government recently said its development arm would invest \$1bn in Kenyan infrastructure and that a British firm would build a new rail hub in central Nairobi. The G7 group of countries last year launched the Build Back Better World initiative, a shameless copy of China's BRI. All this should mean more opportunities for construction firms of all nationalities, whether Western, Chinese or, with a bit of luck, African, too. ■



追赶巨龙

中国公司主导非洲基建

西方企业抱怨多，参与少

说到在非洲大兴土木，中国无可匹敌。受中国政府支持的企业已经重绘了非洲大陆的交通地图。多亏了中国的工程师和银行家，现在你可以避开拥堵的交通，在拉各斯（Lagos）乘火车前往伊巴丹（Ibadan）；只花几个小时就驱车穿越刚果东部的多个地区，而不再需要用上几天；搭飞机抵达从桑给巴尔到赞比亚的几十个近年整饬一新的机场。再加上摩天大楼、桥梁、大坝，以及三十多个港口，建设规模着实浩大。

事情并非一直如此。1990年，欧美公司包揽了非洲超过85%的建筑合同。甚至没人会提起中国公司。如今，西方公司却难以在这个快速增长的市场中赢得业务。（世界银行预测，到2040年，单单基础设施支出的需求每年就将超过3000亿美元）。非洲的人口增速和城镇化速度都比其他大陆快。这两个趋势都将推动需求。大部分基建项目将由中国公司承建。根据咨询公司德勤的数据，2020年，非洲价值5000万美元以上的基建项目有31%（2013年为12%）由中资公司承建，西方公司直接承建的仅约占12%（2013年为37%）。

西方公司大为失势，不仅让它们的股东担忧，也让西方政府担忧——它们认为中国在非洲日益增长的经济力量会强化其战略和外交影响力。中国的“一带一路”倡议向港口、公路和其他基础设施工程提供融资，这让西方的军事将领们担心中国可能会在非洲设立另一个海军基地（它已经在吉布提设了一个）。西方政府还担心中国对非洲矿区的投资会让它掌控战略矿产，比如电动汽车使用的钴。近来，美国已将与中国竞争定为外交政策的核心。美国和欧洲已经在尝试向非洲国家推销替代“一带一路”的融资计划。在2月17日召开的欧盟-非盟峰会上，欧洲领导人公布了向非洲基建投资1500亿欧元（1700亿美元）的粗略计划。

西方政府也在努力引导本国公司加大在非洲的投资和建设。但这说易行

难。一些西方建筑公司抱怨自己从一开始就处于劣势，特别是面对大肆挥霍的中国。据华盛顿智库全球发展中心（Centre for Global Development）的数据，2007年至2020年间，中国的开发银行向非洲基建提供了230亿美元，而其他国家的开发银行总共才提供了91亿美元（见图表）。

中国的贷款机构比西方对手更大胆，有时近乎鲁莽。肯尼亚总统乌胡鲁·肯雅塔（Uhuru Kenyatta）提出想贷款47亿美元来建造一条新铁路，世界银行警告称该项目恐怕永远无法盈利，但中国的贷款机构提供了融资。这条铁路至今已亏损超过两亿美元。通常情况下，中国公司是谈判桌上的厉害角色。几家中国公司已达成资源换基建的交易，例如在加纳和几内亚一些价值超过11亿美元的项目，其中的贷款换取了铝土矿矿权。美国威廉玛丽学院（William & Mary）的“援助数据”（AidData）项目团队的一项研究发现，中国贷款机构通常会提出异常苛刻的条件，以确保贷款会被偿还。

西方公司还抱怨本国政府给非洲提供的甜头比中国少。去年，中国表示将自掏腰包在刚果和肯尼亚建造新的智能化外交部办公楼。中国还为其他许多政府办公楼项目买单，包括塞拉利昂和津巴布韦的议会大楼以及布隆迪、几内亚比绍和多哥的总统官邸。面对这样的慷慨之举，一些非洲政府会偏爱中国公司也就不足为奇了。相比之下，西方政府往往把援助投向一些不起眼甚至有时还不受欢迎的领域，例如女孩教育。

也许最重要的是中国公司“建得快”的名声。中国的开发银行提供的资金会迅速到位，而非洲一些项目看上去像是中国项目的翻版，这想必节省了设计规划的时间。（例如，中国在埃塞俄比亚和吉布提之间新修建的铁路线上的车站看起来就像是直接从亚洲平原上移植过来的）。这样的速度在某种程度上也可能是在环评等方面投机取巧的结果。

因此，中国公司往往可以在一个选举周期内完成一个大型项目，刚好能让现任政府领导人赶在选民投票前风光剪彩。西方公司少有这么手脚利落的。“我们要站上起跑线都难。”欧洲一家工程公司的高管说。

美国智库布鲁金斯学会（Brookings）对世界银行资助的国际项目的一项

研究显示，中国公司能赢得合同的原因往往很简单：它们更具竞争力。西方公司抱怨说部分中资建设项目是豆腐渣工程，而关于它们修建的道路没几年就塌陷的传闻也比比皆是。但另一项由约翰斯·霍普金斯大学中非研究所（China-Africa Research Initiative）对世行资助的基建项目的研究显示，中国承建商和西方承建商的工程质量并无二致。不过，世行向来坚持廉洁投标和高工程标准，所以投标世行项目的公司可能会表现出它们最守规矩的一面。

而在许多情况下，中国公司会拿到工程是因为根本没有竞争对手——许多西方公司认为非洲风险太大，不愿参与进来。这里的确会很危险。由于诈骗横行，产权往往已经模糊不清。一名西方经理说，他所在的财团曾经打算在非洲买地，很久后才发现和谈判的人根本没有那些土地的所有权。

这些困难有助于解释为什么许多基建项目没等铺下第一块砖就告吹了。据另一家咨询公司麦肯锡计算，非洲有80%的基建项目止步于规划阶段，只有一成能完成财务结算。

另一个巨大障碍是腐败。在过去，西方公司常常通过行贿赢得非洲的工程，在其他地方也一样。查尔斯·肯尼（Charles Kenny）撰写的世行论文提到，1999年至2000年间对4000多家公司的调查发现，建筑公司把收入的1%至2%用于行贿。他还指出，在2005年，足足40%的受访国际建筑公司表示，前一年曾因竞争对手行贿而丢掉过合同。

如今，美国和英国加强了反腐败立法，而且不管在哪里行贿，这些法律都适用。因此，西方公司变得更不愿行贿，不过仍有一些公司铤而走险，结果被罚。例如，美国哈里伯顿公司（Halliburton）于2017年因在安哥拉违规被罚款，法国建筑公司布依格（Bouygues）的一家子公司因合同事务上的违规行为遭到世行制裁。

然而，一名西方项目经理抱怨说，非洲一些官员对这类反腐败法规无动于衷，还是会问：“给部长们的棕色信封呢？给常务次官的棕色信封呢？”一

家西方矿业公司的老板抱怨自己受到的束缚太多，相比之下，中国公司可以在没有证照的情况下就开展业务，甚至在中非共和国这样到处是叛军的地方，只要买通地方军阀，没有政府许可也可以运作。

还是有一些西方公司尝试争夺业务，但并不都是愉快的经历。2017年，美国大型建筑公司柏克德（Bechtel）赢得了一份价值27亿美元的合同，承建肯尼亚史上最大的公路项目。肯尼亚政府先是同意预付工程费用，之后又改变主意，转头要求提供贷款。在遭到美国政府拒绝后，肯尼亚政府就搁置了这个计划。

由于五家中国竞争对手未能按时提交标书（似乎是因对竞争性招标不熟悉所致），英国的GBM工程公司（GBM Engineering）不战而胜，赢得了建造肯尼亚最大水坝的合同，价值20亿美元。六个月后，GBM的合同被取消，据称负责招标的政府委员会受到了中方施压。GBM五次上诉获胜，但都被完全无视。现在这个案件仍在法庭上拉锯，而和柏克德公司要建的高速公路一样，肯尼亚的这座大坝也还没开建。

但也并非所有西方高管都只能落得在当地的喜来登酒店里借酒浇愁。位于巴黎的法国社会科学高等学院（School for Advanced Studies in the Social Sciences）的裴天士（Thierry Pairault）指出，越来越多法国公司正在与中国公司合作。起初，这种合作关系是非正式的，法国和中国公司在同一项目中单独完成不同工作，往往由前者负责较复杂的部分。

后来双方的合作变得更加正式。法国物流巨头达飞海运（CMA CGM）已与中国港湾工程公司等企业建立了伙伴关系。法国公司有时是看上了中国合作伙伴能带来法国不提供的政府资助。但也有一些是在多年的非正式合作之后转向了正式合作。德勤发现，在2020年，不少于15%的大型基建项目是由联合体承建的，其中就包括由西方公司和中国公司组成的联合体。

中国参与非洲基建并非有利无弊。在有些情况下，这让相关国家深陷债务泥沼，助长了其国内的腐败，或者建成了像肯尼亚的那条铁路一样永远无法盈利的基础设施。但是，丑闻会被淡忘（债务也会违约），日久年深，

中国留下的将是非洲经济增长急需的道路和港口。

也许同样重要的是，中国在非洲的基建项目加重了西方领导人的地缘政治焦虑，不知不觉间也刺激了西方资金挤入。英国政府最近表示，其开发机构将向肯尼亚的基建项目投资十亿美元，一家英国公司将在内罗毕市中心建造一个新铁路枢纽。七国集团去年发起了“重建美好世界”（Build Back Better World）倡议，无所顾忌地复制了中国的“一带一路”倡议。所有这些应该意味着各个国家的建筑公司都将获得更多机会，不管是西方的还是中国的。走运的话，连非洲的公司也有机会。■



The world economy at war

War and sanctions means higher inflation

But not necessarily higher interest rates

RUSSIA MAY have tried to build a “fortress economy”, but it is the West that currently looks financially impervious. Compared with the deep economic crisis brought about in the country by Western sanctions, the consequences for the rich world have been small. Though American stocks fell sharply when the war started on February 24th, on March 2nd they closed almost 4% higher than their level the night before the invasion. European stocks are about 4% down—a big hit, but nothing compared with the financial rout under way in Russia, where the currency has collapsed and stockmarket trading has been suspended for days.

In part the muted reaction reflects Russia’s low weight in the global economy: about 2% in dollar terms. The country’s relative poverty and smaller population when compared with the rest of Europe mean that its exporters depend on European demand but not vice versa. Goldman Sachs, a bank, estimates that the loss of exports caused by a 10% fall in Russian spending would cost the euro zone only about 0.1% of its GDP, and Britain still less. Financial links are modest.

Yet Russia’s economic importance vastly outweighs its GDP or financial clout owing to its energy exports. It produces nearly a fifth of the world’s natural gas, and more than a tenth of the world’s oil, the price of which drives much of the short-term variation in global inflation. Typically 30-40% of the EU’s gas supply comes from Russia (though this has fallen to about 20% in recent months as Europe has increased its imports of LNG from America). It does not just heat Europe’s homes but also powers much of its industrial production. Among big economies Italy and Germany are particularly exposed.

Energy prices increased dramatically on March 1st and 2nd. European natural-gas spot prices are now more than double their level at the start of February. So are futures prices for delivery in December 2022, reflecting in part the cancellation of the Nord Stream 2 pipeline from Russia to Germany, which had been hoped to ease supply this year. The oil price is up over 25% to about \$115 per barrel. The energy squeeze will worsen Europe's inflation problem while also hitting its growth. JPMorgan Chase, a bank, has raised its forecast for euro-area inflation at the end of the year by 1.1 percentage points, to 3.6%, while cutting its growth forecast for 2022 by 0.6 percentage points, to 4.1%. As a producer of oil and gas America is mostly insulated from the drag on growth, but will feel the inflationary effects of pricier oil.

Things could get much worse should sanctions expand in scope to cover energy purchases or if Russia retaliates against them by reducing its exports. JPMorgan Chase projects that a sustained shut-off of the Russian oil supply might cause prices to rise to \$150 per barrel, a level sufficient to knock 1.6% off global GDP while raising consumer prices by another 2%. The stagflationary shock would carry echoes of the Yom Kippur war of 1973, which sparked the first of the two energy crises of that decade. It greatly worsened an existing inflation problem caused in part by the collapse earlier that year of the Bretton Woods system of fixed exchange rates. Today much pricier energy would be layered atop the inflation caused by the pandemic and the associated stimulus.

If the oil and gas keep flowing, the existing increases in their respective prices will still make life uncomfortable for central banks, who were anyway raising or preparing to raise interest rates. They usually tolerate inflation caused by expensive energy. It tends to quickly dissipate, or even go into reverse. But recently they have worried that the persistence of high inflation since last summer might lead companies to think they should continue to increase prices at a rapid pace and workers to continue to ask

for higher wages. Inflation, in other words, may have taken on a momentum of its own. Further increases in energy prices can only heighten that danger—while adding to the squeeze on growth that higher interest rates bring about.

At present markets are priced for a fairly conventional policy response. Since February 1st investors' inflation expectations, as revealed by the price of swaps, have risen sharply at a one-year horizon for Britain, America and the euro zone. Yet expectations for longer-term inflation, as measured by long-dated forward swaps, have not changed much (see chart). Projections of the ECB's policy rate at the end of the year have barely changed. Investors have priced in another quarter-of-a-percentage-point rise in interest rates this year in both Britain and America. On March 2nd Jerome Powell, chairman of the Federal reserve, indicated that it would still raise rates.

There have, however, been sharp movements in bond yields at longer horizons. In mid-February yields on five-year German government bonds had been in positive territory for the first time since 2018. They have since fallen to about -0.25%. On March 1st and 2nd the yield on an American ten-year Treasury bond fell from nearly 2% to 1.7%, a greater fall than in any two-day trading period since March 2020, before recovering slightly to 1.9% the next day.

In other words, investors are betting that today's inflation, even once exacerbated by the war in Ukraine, will be temporary—and that over the long term interest rates are likely to be a bit lower than on past projections. But that hardly means markets are sanguine. In recent years some scholars have argued that low long-term real interest rates reflect in part the impulse to hoard safe assets as tail risks—rare but highly costly events—grow more likely. After two years of a pandemic and with war raging in Europe, that thesis has never seemed so apposite.

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战时全球经济

战争和制裁意味着通胀上升

但利率不一定会上升

俄罗斯或许试图建立一个“堡垒经济”，但目前看来，在金融上固若金汤的是西方。西方制裁给俄罗斯带来了严重的经济危机，相比之下富裕国家所受的影响不大。美国股市尽管在2月24日战争开始时大幅下跌，但在3月2日收盘时却比俄罗斯对乌开战前一晚上涨了近4%。欧洲股市下挫约4%——跌幅不小，但和俄罗斯眼下的金融崩溃比起来微不足道。卢布已经暴跌，俄罗斯股票交易已暂停多日。

在一定程度上，这种哑火的反应表明俄罗斯在全球经济中所占的比重之低：以美元计算仅为2%左右。与欧洲其他国家相比，俄罗斯相对贫穷，人口较少，这意味着它的出口商依赖于欧洲的需求，而不是反过来。据高盛估计，俄罗斯支出每下降10%，对欧元区所造成的出口额损失仅相当于其GDP的约0.1%，对英国造成的损失占比还要更低。它们之间的金融联结并不紧密。

不过，因为能源出口，俄罗斯的经济重要性远远超过其GDP或金融影响力。它生产了全世界近五分之一的天然气和超过十分之一的石油，而油价驱动了全球通胀短期波动的很大一部分。通常欧盟天然气供应有30%至40%来自俄罗斯（尽管近几个月来，由于欧洲增加了从美国进口的液化天然气，这一比例已下降到20%左右）。它不仅为欧洲的家庭供暖，也为那里的许多工业生产提供能源。在大型经济体中，意大利和德国对俄罗斯天然气的依赖尤其严重。

3月1日和2日，能源价格大幅上涨。欧洲天然气现货价格升至2月初水平的两倍多。2022年12月交割的天然气期货价格也是如此，这一定程度上反映了从俄罗斯通往德国的北溪二号（Nord Stream 2）管道项目被叫停的影响，人们原本希望它能缓解今年的供应紧张。油价上涨了25%以上，增至每桶115美元左右。能源短缺将加剧欧洲的通胀问题，同时也会损害其经

经济增长。摩根大通将欧元区年底的通胀预期上调1.1个百分点，至3.6%，同时将2022年的增长预期下调0.6个百分点，至4.1%。美国是石油和天然气的生产国，经济增长基本不受能源短缺拖累，但会感受到油价上涨带来的通胀效应。

如果制裁范围扩大到能源采购，或者俄罗斯通过减少能源出口来报复制裁，情况可能会糟糕得多。摩根大通预计，俄罗斯石油供应如持续中断可能导致油价升至每桶150美元，这足以让全球GDP下降1.6%，同时让消费者价格再上涨2%。这种滞胀冲击会让人回想起1973年的第四次中东战争，那场战争引发了1970年代两次能源危机中的第一次。那一年更早些时候固定汇率的布雷顿森林体系崩溃，一定程度上引发了通胀上升，能源危机又极大地恶化了通胀问题。今天，能源价格高涨将让疫情和相关刺激措施造成的通胀上升雪上加霜。

如果石油和天然气继续保持供应，它们已经发生的那部分涨价仍会让央行的日子不好过，因为央行不是在加息就是在准备加息。央行通常会容忍由昂贵的能源引起的通胀，这样的通胀往往会迅速消解甚至逆转。但最近央行担心，自去年夏天以来持续的高通胀可能会让企业觉得它们应该继续快速提高价格，而工人们也会继续要求加薪。换言之，通胀可能已经进入自我驱动。能源价格的进一步上涨只会加重这一危险——同时还会加剧利率上升对经济增长的挤压。

目前的市场定价对应的是相当常规的政策反应。正如掉期价格所示，自2月1日起，在英国、美国和欧元区，投资者的一年通胀预期急剧上升。不过，以远期掉期来衡量的长期通胀预期并没有多大变化（见图表）。对欧洲央行年底政策利率的预测几乎没有改变。投资者已经把英国和美国今年利率将再次上升25个基点的预期考虑在内。3月2日，美联储主席杰罗姆·鲍威尔暗示美联储仍将加息。

但是，长期债券的收益率出现了剧烈波动。2月中旬，五年期德国国债收益率自2018年以来首次来到正值。之后又降至-0.25%左右。3月1日和2日，美国十年期国债收益率从近2%跌至1.7%，超过2020年3月以来任何两个交

易日内的跌幅，次日略回升至1.9%。

换句话说，投资者赌的是，就算今天的通胀因乌克兰战争加剧，也将是暂时的——而且长远来看利率可能会比过去的预测略低。但这绝不意味着市场是乐观的。近年来一些学者认为，长期实际利率低在一定程度上反映了人们囤积安全资产的冲动，因为尾部风险——也就是很少发生但代价高昂的事件——越来越有可能发生。在欧洲经历了两年的疫情又陷入战争的硝烟之际，这种论点似乎从未如此恰当。





Schumpeter

How Europe's commodities traders took a gamble too far on Putin's regime

This is one war they may not be able to win

IN RUSSIA'S FROZEN north is a megaproject that has long been seen as an answer to President Vladimir Putin's prayers. By the mid-2020s the Vostok oilfield is expected to supply about 15% of Russia's crude exports. By that time Rosneft, the Russian oil giant leading the effort, plans to ship Vostok oil via the Northern Sea Route, a shortcut through the Arctic to Asia. The route will enable Russia to bypass the West geopolitically as well as geographically, allowing oil to travel along waters beyond the control of the American navy and out of reach of Western sanctions. Besides Rosneft, its backers include two mostly European oil and gas traders, Trafigura and Vitol. For years they have competed fiercely to be among the biggest buyers of Russian crude.

These firms are part of a group of commodities traders, including Glencore and Gunvor, that often thrive amid geopolitical turmoil. They are clear-eyed realists who in the past have struck deals with autocrats to gain access to cheap raw materials. In recent years some have doubled down on Russia, doing business with the figures who surround Mr Putin, such as Rosneft's boss, Igor Sechin, and winning big oil and liquefied natural gas (LNG) contracts (piped gas is the domain of Gazprom, a state monopoly). The arrangement served both sides well. The traders invested in Russia and secured more supply from the world's third-biggest oil-producing country and biggest natural-gas exporter. Higher energy prices bolstered Russia's hard-currency reserves.

But if they believed Mr Putin's goal was a modern economy that he would not jeopardise by invading Ukraine, they were wrong. In fact, oil revenues

have financed an ever more autocratic and belligerent regime. After the West moved to strengthen penalties on Russia's financial system on February 26th, they faced the consequences of their bet. As one executive put it two days later, everything in the Russian oil business was "frozen": banks, ports, ships and suppliers. Auctions of Russian crude found no buyers. Prices of oil soared on global markets but so did the discounts on Russian Urals crude relative to international benchmarks. Amid fear of sanctions, Russian cargoes became kryptonite.

Some traders initially said the paralysis would be short-lived. After all, oil and gas producers were spared sanctions in order to keep Russian energy flowing to the West. One executive described the biggest risk as "overzealous bank compliance officers" causing more damage to Russia's oil market than the architects of sanctions intended. Yet the traders may have been in denial. The speed with which two European supermajors, BP and Shell, pledged to dump their Russian assets suggested that political and social pressure to withdraw from Russia was mounting in the wake of the invasion. On March 1st Glencore said it was reassessing its equity stakes in EN+, an Anglo-Russian aluminium producer, and Rosneft. A day later Trafigura said it was reviewing its investment in Vostok Oil as it unconditionally condemned the war. Usually the trading houses thrive in times of conflict by keeping their heads down and capitalising on volatility. Not this time. Russia's war on Ukraine suggests their gamble on Mr Putin may have been a throw of the dice too far.

In theory, excluding Russian oil and gas from sanctions should enable the trading houses to continue their day-to-day operations. In practice, it does not because energy trading is as much about the flow of money as of molecules. Cargoes are financed by banks. They require letters of credit guaranteeing payment. They involve frequent messaging between banks working for the buyers and sellers. Until March 1st, when names were released of the seven Russian lenders potentially blocked from the SWIFT

interbank-communications system, many energy-related transactions in Russia were halted, traders said, owing to the counterparty risk. Moreover, fears surfaced that as Russia's aggression on Ukraine escalates, sanctions will be strengthened. "The tit has to be reasonably in line with the tat," says Jean-François Lambert, a commodities consultant.

The problem is exacerbated by the length of time cargoes of oil and LNG spend at sea. By the time they reach port, sanctions on Russian energy may be in place. "The biggest grey area is that no one knows what comes next," says Daniel Martin, who specialises in shipping rules at HFW, a law firm. Logistical chaos compounds the uncertainty. Oil-tanker rates on the Black Sea adjacent to Russia and Ukraine have surged as fighting has intensified.

As well as business risks, the trading firms face reputational ones. This is exacerbated by long-standing links with firms and individuals at the heart of the regime. In "The World for Sale", a recent book, the authors argue that the merchants have probably been more engaged with Mr Putin's autocracy than anyone in the world of international business. Despite a stand-off between Russia and the West, they made vast loans to Rosneft in exchange for oil-supply deals. Two years after Russia seized Crimea in 2014, Glencore co-invested \$11bn to buy part of the Russian government's stake in Rosneft (it has since sold almost all of it). After Trafigura and Vitol invested in Vostok, they received supply deals from Rosneft. Mark Rossano, CEO of C6 Capital Holdings, a consultancy, believes that both the oligarchs and the traders were caught out by the economic reprisals that the war has unleashed.

| *Merchant misadventurers*

They will survive. Even with business in Russia in free fall, crisis breeds opportunity. As Western countries such as America release strategic reserves of crude to stop the price of oil soaring, they are queuing up for cargoes. If Western sanctions on the sale of Iranian oil are lifted so that it

can offset a potential loss of Russian crude, they have the contacts to move the stuff. But these are dangerous times. The West's reaction to Mr Putin's war is visceral. It is one thing to be considered a non-aligned merchant providing the world with what it needs. It is another to be seen as a mercenary. ■



熊彼特

欧洲大宗商品交易商对普京政权下的赌注太大

这可能是一场它们赢不了的战争

在俄罗斯冰天雪地的北方地区有一个特大项目，一直被认为能达成普京的祈愿。到2025年左右，沃斯托克油田（Vostok）供应的原油有望占到俄罗斯原油出口量的约15%。到那时，主导这个项目的石油巨头俄罗斯石油公司（Rosneft）计划经由北海航线（Northern Sea Route）运送沃斯托克石油。这条航线是穿过北极到达亚洲的捷径，它将让俄罗斯在地理上同时也是在地缘政治上绕过西方，让它可以在美国海军控制范围之外的水域运输石油，而不受西方制裁的影响。除了俄罗斯石油公司，它的投资方还包括两家主要在欧洲经营的石油和天然气交易商托克（Trafigura）和维多（Vitol）。这两家公司多年来都在为跻身俄罗斯原油的最大买家之列激烈竞争。

包括嘉能可（Glencore）和贡渥（Gunvor）在内的一批大宗商品交易商往往在地缘政治动荡中如鱼得水，上述两家公司也在此列。它们是精明的现实主义者，过去就和独裁政府做交易以获得廉价的原材料。有几家近年来对俄罗斯加倍下注，与俄罗斯石油公司老板伊戈尔·谢钦（Igor Sechin）等普京的亲信做生意，拿下了很多石油和液化天然气（LNG）的大合同——管道天然气是国有垄断企业俄罗斯天然气工业股份公司（Gazprom）的地盘。这么做让双方都得到了好处。这些交易商在俄罗斯投资，从这个世界第三大产油国和头号天然气出口国获得了更多的能源供应。而上涨的能源价格巩固了俄罗斯的硬通货储备。

但是，如果它们以为普京的目标是建立一个现代经济，为了不损害它也不会入侵乌克兰，它们想错了。事实上，石油收入资助了一个越来越独裁与好战的政权。在2月26日西方采取行动加大对俄罗斯金融体系的惩罚后，它们面临着自己押注的后果。正如一位高管在两天后所说的，俄罗斯石油业务的各个环节都“被冻结”了，包括银行、港口、船舶和供应商。俄罗斯原油拍卖找不到买家。全球市场上油价飙升，但俄罗斯乌拉尔（Urals）

原油相对于国际基准价格的折扣也大幅上升。由于担心受制裁，俄罗斯的原油成了大家避之不及的烫手山芋。

一些交易商起初表示，这种瘫痪状态会很短暂。毕竟，过去为了让俄罗斯的能源源源不断地流向西方，石油和天然气生产商都幸免于制裁。一名高管称，最大的风险是“过于尽职的银行合规官”，他们对俄罗斯石油市场造成的损害超过了制裁设计者的本意。然而，这些交易商可能一直在拒绝接受现实。BP和壳牌这两家欧洲超级石油巨头承诺抛售自己在俄罗斯的资产，其反应的速度之快表明，在俄罗斯入侵乌克兰之后，要求它们撤出俄罗斯的政治和社会压力正在加大。3月1日，嘉能可表示正在重新评估自己持有的英俄合资铝生产商EN+和俄罗斯石油公司的股权。3月2日，托克表示自己无条件谴责这场战争，正在重新评估对沃斯托克石油的投资。在冲突时期，贸易公司一般都会低调行事，并利用市场动荡大发其财。但这次不同。俄罗斯对乌战争表明，它们在普京身上的押注可能太大了。

从理论上讲，将俄罗斯的石油和天然气排除在制裁之外应该能让这些贸易商继续日常经营。但实践中却并非如此，这是因为能源交易既关乎油气分子的流动，也关乎金钱的流动。能源交易由银行提供资金。交易需有信用证作为付款担保。为买卖双方服务的银行之间还要频繁地传递信息。3月1日，可能被逐出银行间通信系统SWIFT的七家俄罗斯银行的名单公布。交易商表示，在此之前，在俄罗斯的许多能源相关交易都因交易对手风险而被中止。此外，人们还担心，随着俄罗斯对乌克兰的侵略升级，制裁力度将会加大。“以牙还牙的力度必须要够。”大宗商品交易顾问让-弗兰索瓦·兰伯特（Jean-François Lambert）表示。

石油和LNG要在海上长时间运输，让问题变得更加严重。等到它们抵达港口时，对俄罗斯能源的制裁措施可能开始执行了。“最不确定的就是没人知道接下来会发生什么。”夏礼文律师事务所（HFW）专门研究航运规则的丹尼尔·马丁（Daniel Martin）表示。物流的混乱加剧了不确定性。随着战事加剧，在邻近俄罗斯和乌克兰的黑海，油轮运价已经大幅上涨。

除了商业风险，这些贸易公司还面临声誉上的风险。与处于普京政权中心

的公司和个人之间的长期联系加剧了这种风险。近期出版的《待售的世界》（The World for Sale）一书的作者认为，这些交易商与普京独裁政府的关系可能比国际商界的任何人都更密切。尽管俄罗斯与西方陷入僵局，它们还是向俄罗斯石油公司提供了巨额贷款以换取石油供应协议。就在俄罗斯2014年占领克里米亚的两年后，嘉能可和其他投资者共同拿出110亿美元，购买了俄罗斯政府在俄罗斯石油公司的部分股权（后来它几乎出售了所有股权）。托克和维多在投资了沃斯托克之后，获得了俄罗斯石油公司的供应协议。咨询公司C6 Capital Holdings的CEO马克·罗萨诺（Mark Rossano）认为，无论是寡头政治家还是交易商，都被战争引发的经济报复行动弄了个措手不及。

| 交易商之厄

它们会挺过去。尽管在俄罗斯的业务一落千丈，但危机也孕育着机遇。当美国等西方国家为阻止油价飙升而释放战略原油储备时，它们排着队去购买。假如西方国家为抵消俄罗斯原油供应减少而解除对伊朗石油销售的制裁，它们也有关系来运输这些石油。但这是危险的时期。西方对普京发动战争的反应发自肺腑地强烈。被看作是为世界提供所需物资的中立商人倒还不算坏，被认为唯利是图就麻烦了。■



The Economist Film

The true costs of ageing - part 1

More flexible attitudes to retirement could help reduce the economic burden of increasingly elderly populations.



经济学人视频

老龄化的真实代价（上）

以更灵活的态度看待退休，能够减轻老年人口持续增长带来的经济负担。



Conservation conversation

China is trying to become a champion of biodiversity

It has a lot of ground to make up

CHINA'S IMPRIMATUR on the “Kunming declaration” goes beyond its name. Signed by over 100 countries in October, the pledge set the tone for COP15, the largest UN biodiversity gathering in a decade. (First scheduled for 2020, it was delayed several times because of covid-19.) The conference, taking place in two parts, is being hosted by China for the first time. Its second meeting was scheduled for April but also looks likely to be postponed. The host city is the capital of Yunnan, a south-western province that is a showcase of the biodiversity that China needs to preserve, from steamy jungle to mountain glaciers.

As a forum in which China can demonstrate its green leadership credentials, COP15 has a special appeal. The country is alert to the importance of global norms on mitigating climate change. Even when in dispute on other matters, America and China have shown co-operation on limiting emissions. But, with a Senate that has a poor record for ratifying environmental treaties, America is not a party to the UN's convention on biodiversity, which was signed into force by over 190 member states in 1993. That lets China run this show. The theme for Kunming is its homegrown idea of sustainable growth: “ecological civilisation”.

The term was written into China's constitution in 2018, suggesting how central it now is in guiding development. The Kunming declaration is filled with other favourite greening concepts of the Communist Party, including the “two-mountains theory”, attributed to President Xi Jinping. This states that “green mountains are gold mountains”: that is, the environment can no longer be sacrificed for development.

For decades, China pursued single-minded economic growth, which allowed millions to lift themselves out of poverty. But pollution and over-exploitation damaged wildlife and habitats. The number of China's terrestrial vertebrate species—a good indicator of biodiversity—has halved since 1970. More than one in five surviving species faces extinction. In the five decades to 2000 over half of the country's mangroves—essential breeding grounds for aquatic life—disappeared. Some 90% of grasslands are at varying stages of degradation or desertification, and almost half of wild-animal populations are in decline, decimated by the illegal trade in wildlife.

Yet, despite the ravages of urbanisation, China has much left to protect. It is home to 10% of the world's plant species, 14% of animal ones and 20% of fish. At the second meeting, delegates will set goals for 2030 to preserve global plant and animal life. The stakes are high. Signatories failed to meet any of the targets they set for themselves in 2010, when they last met, in Japan. In October Mr Xi launched the Kunming Biodiversity Fund, to which China has contributed 1.5bn yuan (\$230m). Li Shuo of Greenpeace, an NGO, says this larger commitment “could be the impetus others need” to spend more. Mr Xi also announced the formal opening of five national parks, spanning 230,000 sq km, home to over a quarter of China's terrestrial wildlife species. (America's 63 national parks cover 340,000 sq km.)

Still, China's broader commitment is far from clear. In 2020, in a speech to the UN General Assembly, Mr Xi unexpectedly committed the country to carbon neutrality by 2060. Then in September he announced that the country would not finance new coal projects abroad. But for now, China remains the largest consumer of coal and emitter of carbon dioxide. Success in stemming deforestation is mitigated by its parallel rise as the world's largest importer of wood. Greenpeace called the Kunming declaration “a toothless tiger”.

Keeping citizens happy is becoming a powerful incentive for China. They are vocal about more than polluted water and toxic air. The global debate about the origins of covid-19 has put a focus on the costs of destroying habitats and trading wildlife. In February 2020 China's legislature expanded the scope of its wildlife protection law to ban the consumption of almost all wild animals. In a report published in January, the World Economic Forum estimated that 65% of China's GDP, or \$9trn, is "at risk of disruption from nature loss".

| *No mangrove is an island*

Perhaps no province so clearly illustrates that trade-off than the island of Hainan, a lush tourist hotspot off the southern coast. Last year its white sandy beaches and monstrous resorts drew 80m (almost entirely domestic) tourists. Some came for the newly opened Hainan Tropical Rainforest National Park, one of the five scenic areas announced by Mr Xi. Though covering just 4,400 sq km, the rainforest is home to nearly 20% of China's amphibian species and almost 40% of its bird species.

Hainan is China's smallest province, so it is hardly representative. But it is a useful case study, because it is straining under the excesses of tourism and development while trying to protect its environment. Those goals are usually in conflict. But local NGOs are hoping that, if managed well, tourism can be part of the solution. They have little choice: such pressures will only grow as Hainan transforms into a vast free-trade port, as called for in plans unveiled in 2020. The island wants its duty-free market to grow tenfold by 2025, to \$50bn.

In the 1950s, jungle was cleared for state farms producing rubber. At that time, there were about 2,000 Hainan gibbons in the area. By 1970 only around ten were left, and it is still the world's rarest primate (pictured). But now, Hainan is being praised for its rescue efforts, which include replanting the ape's favourite lychee and fig trees. In September the park

announced that two babies had brought the population to 35.

Preservation extends beyond the park. At COP15, China aimed to become the first country to put 30% of its land and sea under protection by 2030. Hainan has already drawn a “red line” around 27% of its land and 35% of its coastal waters: any construction in these zones that harms the environment is banned. Land reclamation, shrimp ponds and sewage discharge have long contributed to mangroves’ disappearance. Now Hainan is halting such encroachment and replanting trees. National mangrove coverage increased by almost half between 2000 and 2019, to 30,000 hectares.

Local initiatives help. Blue Ribbon Ocean Conservation Association, a local NGO, patrols mangroves, clearing away invading species. Its data-collection methods on coastal walks have been adopted elsewhere. In Meilian, a pilot village, it has got fishermen to use nets with larger mesh.

Young visitors are starting to pay a premium for sustainable produce. They want to enjoy a nice environment, says Pu Bingmei of Blue Ribbon. More are joining in ocean-conservation activities on holiday, such as the beach clean-ups that her NGO organises. In late 2020 Hainan became the first province to ban single-use plastic.

The youngest mangrove forest is in Tongqi Bay. A wiry fisherman says he has been banned from farming whelks in shallow coastal pools.

“Mangroves mean more fish, more shrimp, more whelks,” he says, as if reciting. Ms Pu hopes that shoppers’ cash will boost local-government funding for eco-projects. But, she says, “As tourism grows year by year, Hainan will forever need to find a new balance.” ■



生态保护对话

中国立志要成为生物多样性的捍卫者

这任重而道远

中国对《昆明宣言》的支持并不仅仅是因为它的名字。去年10月，100多个国家签署了这一承诺，为十年来最大规模的联合国生物多样性会议COP15定下了基调。（大会原定于2020年举行，但因新冠疫情多次推迟。）这次会议将首次由中国主办，分为两部分举行。第二次会议原定于今年4月举行，但看起来也很可能要延后。主办城市是中国西南部云南省的省会，云南既有潮热的丛林也有高山冰川，集中体现了中国需要保护的生物多样性。

作为一个能让中国展示绿色领导权威的论坛，COP15具有特殊的吸引力。中国清楚意识到全球规范在减缓气候变化上的重要性。即使在其他事务上存在争议，美国和中国在限制排放方面仍然表现出了合作意愿。但是，由于环保条约在美国参议院总是受阻，美国并不是联合国《生物多样性公约》（由190多个成员国于1993年签署生效）的缔约国。这让中国得以主持大局。昆明会议的主题正是中国提出的可持续发展理念：“生态文明”。

这个表述在2018年被写入中国宪法，体现出它在指导发展中的重要地位。

《昆明宣言》里有大量中国共产党爱用的其他绿色概念，包括国家主席习近平提出的“两山理论”。该理论称“绿水青山就是金山银山”，也就是说，再也不能以牺牲环境来换取发展。

几十年来，中国一心一意追求经济增长，让几亿人摆脱了贫困。但是污染和过度开发损害了野生生物和栖息地。陆生脊椎动物的种类是衡量生物多样性的一个重要指标，在中国它们自1970年以来已经减少了一半。而存留下来的种类中有超过五分之一濒临灭绝。红树林是水生动物的重要繁殖地，从1950年到2000年的50年间中国一半以上的红树林消失了。大约90%的草原正处于不同程度的退化或沙漠化，而非法野生动物贸易导致将近一半的野生动物种群在缩减。

然而，尽管城镇化造成了巨大破坏，中国仍剩余大量需要保护的资源。中国拥有地球上10%的植物物种、14%的动物物种和20%的鱼类。在第二次会议上，各国代表将设定到2030年的全球动植物保护目标。这关系重大。各签约国上一次在2010年日本会议上给自己设定的目标最终一个也没实现。习近平在去年10月宣布成立昆明生物多样性基金，中国出资15亿元。非政府组织绿色和平的李硕认为，中国这一更大的承诺“可能会激励其他国家”加大投入。习近平还宣布正式设立五个国家公园，占地23万平方公里，容纳超过四分之一的中国陆生野生动植物物种。（美国的63个国家公园占地34万平方公里。）

然而，中国更大范围的投入还远不清晰。2020年，习近平在联合国大会上发表演讲时出人意料地宣布中国将争取在2060年前实现碳中和。然后在当年9月，他宣布中国将不再为新的海外煤炭项目提供资金。但就目前而言，中国仍是最大的煤炭消费国和二氧化碳排放国。中国在遏制森林砍伐的同时又晋升为世界最大的木材进口国，令成效大打折扣。绿色和平称《昆明宣言》是“没牙的老虎”。

安抚民众正成为中国行动的一大诱因。人们不仅仅在抱怨受污染的水和有毒的空气。关于新冠病毒起源的全球辩论让人们注意到破坏栖息地和买卖野生动物所付出的代价。2020年2月，中国的立法机关扩大了野生动物保护法的范围，禁止食用几乎所有野生动物。世界经济论坛在1月发表的报告中估计，中国GDP的65%（约为9万亿美元）“因自然环境损失而面临风险”。

| 没有哪片红树林是一座孤岛

恐怕没有哪个省份比海南岛更能清楚体现这种权衡取舍。这个南部海岸的旅游胜地到处郁郁葱葱，有着洁白的沙滩和巨大的度假酒店，去年吸引了8000万名游客（几乎全部来自国内）。部分游客正是因为新开放的海南热带雨林国家公园而来，这是习近平宣布的五个国家公园之一。虽然面积仅4400平方公里，但这片雨林却拥有中国近20%的两栖类和近40%的鸟类。

作为中国最小的省份，海南并不具有代表性。但它是一个有益的研究案例，因为它一边承受着旅游业不断扩张和开发过度的压力，一边要努力保护自身环境。这些目标往往彼此冲突拉扯。但当地的非政府组织希望，如果管理得当，旅游业可以成为解决方案的一部分。他们别无选择：2020年宣布的计划要将海南发展成巨大的自由贸易港，在转型过程中这种压力只会越来越大。海南岛希望其免税市场到2025年能增长10倍，达到500亿美元。

在1950年代，岛上大片森林遭砍伐，腾出地来让国营农场种植橡胶。当时，该地区约有2000只海南长臂猿。到1970年只剩下大约10只，至今仍是世界上最稀有的灵长类动物（如图）。而现在，海南拯救这种长臂猿的行动受到了赞扬，包括重新种植它们最喜爱的荔枝和无花果树。去年9月，该国家公园宣布，两只婴猿的诞生使种群数量达到35只。

生态保护并不只局限在这个国家公园内。在COP15大会上，中国立志到2030年成为第一个将30%的陆地和海洋面积都划入保护区的国家。海南已经对27%的陆地和35%的沿海水域划定了“红线”：禁止在这些区域进行任何危害环境的建设活动。长期以来，填海造地、养虾池和污水排放导致了红树林大片消失。现在海南正在叫停这些侵占行为，并重新植树。2000年至2019年间，全国红树林覆盖面积增加了近一半，达到3万公顷。

地方上自发的举措也发挥了作用。当地NGO蓝丝带海洋保护协会正在巡护红树林，清除入侵物种。它在沿海巡行时收集数据的方法已经推广到其他地方。在试点的梅联村，蓝丝带还说服渔民改用网眼更大的渔网。

年轻的游客开始为可持续农产品支付溢价。“他们想享受美好的环境。”蓝丝带的蒲冰梅说。越来越多的人在假期参加海洋保护活动，比如蓝丝带组织的净滩行动。2020年底，海南成为首个禁止使用一次性塑料制品的省份。

最年轻的红树林在桐栖湾。一名精瘦的渔民说，他已经被禁止在沿海浅水池中养殖海螺。“有红树林就会有更多鱼，更多虾，更多海螺。”他吟诵般

地说道。蒲冰梅希望消费者带来的现金能让当地政府支持生态项目。但她也说：“旅游业每年都在增长，海南永远都需要找到新的平衡。”■



Free exchange

Vladimir Putin's Fortress Russia is crumbling

The chaos in Russian markets shows the impossibility of economic "self-reliance"

FOLLOWING RUSSIA'S invasion of Ukraine, an economic war has begun. The West has imposed unprecedented sanctions. Investors are dumping Russian assets as fast as they can. So far this year the rouble has lost one-third of its value. The government may soon default. Capital Economics, a consultancy, expects Russian inflation to hit 15% before long, with GDP falling by 5% this year.

The ructions in Russia's markets have taken many by surprise. For years President Vladimir Putin had, apparently successfully, built up Russia's economic defences, such that it would easily be able to resist whatever Western governments threw at it—what Timothy Ash of BlueBay Asset Management dubbed the "Fortress Russia" strategy. It turns out that the strategy has been a failure. "From Fortress Russia to Rubble Russia in a week," says Mr Ash.

Fortress Russia was a product of Russia's chaotic recent history. Following the dissolution of the Soviet Union in 1991 inflation exceeded 2,000%. In 1998 Russia defaulted, causing the value of the rouble to fall by more than two-thirds. Then in 2014 a collapse in oil prices, plus international sanctions over Russia's actions in Crimea and the Donbas, sent the economy into a deep recession.

As Fiona Hill and Clifford Gaddy show in "Mr Putin: Operative in the Kremlin", a book published in 2015, the Russian president has long wished that his country could be self-reliant. Since 2014, however, that ideology has gone into overdrive, with Mr Putin desperate to ensure that the West could never again exert economic control over his country.

The idea for Fortress Russia went something like this. On the economic front, Russia would diversify its economy away from oil and gas, two volatile commodities. It would lessen its dependence on Western technology and trade. On the financial front, it would reduce external debt. It would practise tight fiscal and monetary policy, allowing it to accumulate vast amounts of foreign exchange with which it would be able to defend the rouble, or that it would channel to favoured companies, at times of crisis.

There have been some successes. Take the economy first. Russia is somewhat less dependent on hydrocarbons. In 2019 oil profits accounted for about 9% of GDP, down from around 15% when Mr Putin took office. Oligarchs remain exceptionally powerful, controlling a huge share of overall Russian wealth, but their influence appears to have stopped growing. Between 2000 and 2019 Russia's services industry grew by seven percentage points of GDP, even if productivity growth in most sectors has been pitiful.

In some areas Russia has developed technologies which operate independently of Western ones. Mir, a Russian payments system, accounted for a quarter of domestic card transactions in 2020, up from nothing five years ago. The share of Russian imports classed as "high-tech" seems to be falling fast, World Bank data suggest. In the past decade European exports of whizzy products to Russia have stagnated, while growing elsewhere.

But the fortress walls have gaping holes. Russia remains enmeshed in the supply chain of Western ideas and technologies. According to our analysis of bilateral data on stocks of long-term investment (control of companies, say, or the construction of new factories), the Russian economy is somewhat more reliant on the West than it was a decade ago. About 30% of Russian imports come from G7 countries, hardly different from 2014. In some industries, such as chipmaking and computers, Russia remains

wholly dependent on American parts. The cards of some Russian banks under sanction no longer work with Apple Pay or Google Pay, which on February 28th caused chaos on the Moscow metro as people could not get through the turnstiles.

The chaos in Russia's financial markets has been an even bigger surprise. After all, by 2022 Russia had \$630bn-worth of international reserves (around 40% of GDP), the most ever, and had diversified away from American dollars. It had also greatly reduced its foreign-denominated debt owed to foreigners since 2014.

But the country remains dependent on foreign investors. Their short-term asset holdings (including bank loans and stocks), relative to GDP, are about as high in Russia as they are in other emerging markets—and they have remained steady since 2014. Even without sanctions, Russian assets would be under huge pressure as investors run for the exits.

And Russia always assumed that it would be able to access foreign exchange to defend the rouble. It is not completely cut off: Russia's energy exports have largely escaped Western bans, so it still has some dollars flowing in. But, because of sanctions, 65% of Russia's reserves may in effect be worth \$0. The other 35%, held in gold and yuan, cannot be used to defend the currency in the dollar and euro markets.

Russia's difficulties will only compound over time. Being shut out of the SWIFT financial-transfer system will hurt trade; SPFS, a Russian-backed rival, remains far less popular. Russia still needs dollars to pay for a third of its imports, a problem when it has suddenly become harder to get hold of them. Even in its imports from China, where progress has been made on "de-dollarisation", around 60% of transactions still take place using the greenback.

| *A test from God*

The question is whether Mr Putin really cares about all this. He may not welcome the prospect of angry oligarchs, should some of them indeed dare to raise their voice. But, according to Ms Hill and Mr Gaddy's book, a core tenet of Putinism is survivalism, where one sees economic warfare as a test of strength. The pain is the point. "In this narrative, Russia constantly battles for survival against a hostile outside world," they say. "The one critical lesson from history is that Russia, the state, always survives in one form or another." Russia faces a deep recession. But rather than relent, Mr Putin may double down on his attempts to cut Russia off from the outside world. ■



自由交流

普京的俄罗斯堡垒正在崩塌

俄罗斯市场的混乱表明经济“自力更生”不可能

俄罗斯入侵乌克兰后，一场经济战也随之引爆。西方国家实施了史无前例的制裁。投资者争相抛售俄罗斯资产。今年以来卢布已经贬值三分之一。俄政府走到债务违约边缘。咨询公司凯投宏观（Capital Economics）预计，俄罗斯的通胀率不久将达到15%，而今年GDP将下跌5%。

俄罗斯的市场动荡让许多人感到意外。多年来，普京在表面上成功地建立了俄罗斯的经济防御体系，使其能够轻松抵御西方政府的任何打击——蓝湾资产管理（BlueBay Asset Management）的蒂莫西·阿什（Timothy Ash）称之为“俄罗斯堡垒”。事实证明，这一战略是失败的。“从俄罗斯堡垒到俄罗斯废墟只用了一周时间。”阿什说。

俄罗斯堡垒是俄罗斯近几十年动荡的产物。1991年苏联解体后，通胀率突破2000%。1998年俄罗斯债务违约，导致卢布贬值超过三分之二。而后是2014年，油价暴跌叠加俄罗斯对克里米亚和顿巴斯的军事行动招致国际制裁，经济陷入严重衰退。

正如菲奥纳·希尔（Fiona Hill）和克利福德·盖狄（Clifford Gaddy）在2015年出版的《普京：克里姆林宫的特工》（Mr Putin: Operative in the Kremlin）一书中所述，这位俄罗斯总统长久以来都希望他的国家能够自力更生。但自2014年起，这种意识形态开始狂飙突进，普京不顾一切地要确保西方再也不能从经济上控制俄罗斯。

俄罗斯堡垒的构思大致是这样的：在经济方面，俄罗斯将减少对石油和天然气这两种波动不定的大宗商品的依赖，实现经济多元化。这将减少俄罗斯对西方技术和贸易的依靠。在财务方面，将减少外债，实施从紧的财政和货币政策，从而积累大量外汇，以便在危机时期捍卫卢布，或者向受扶持的企业提供资金。

这项策略取得了一定的成功。首先在经济上，俄罗斯对油气资源的依赖有所降低。2019年，石油利润约占GDP的9%，低于普京上台时的15%左右。寡头依然异常强大，控制着俄罗斯总财富的很大一部分，但它们的影响力似乎已经不再扩大。2000年至2019年间，俄罗斯服务业占GDP的比例增长了7个百分点，尽管大多数行业的生产率增速都微不足道。

在一些领域，俄罗斯已经开发出独立于西方的技术。2020年，俄罗斯支付系统Mir占据了国内银行卡交易的四分之一，而五年前份额还是零。世界银行的数据显示，俄罗斯进口的“高科技产品”所占比例似乎正在迅速下降。在过去的十年里，欧洲对俄罗斯的高精尖产品出口停滞不前，而对其他地区的出口却在增长。

但是堡垒的城墙有巨大的裂口。俄罗斯仍然深嵌在西方思想和技术的供应链中。根据我们对长期投资存量（例如公司控股，或建设新工厂）的双边数据分析，俄罗斯经济比十年前更加依赖西方一些了。俄罗斯约30%的进口来自七国集团（G7），与2014年时几无不同。在芯片制造和计算机等行业，俄罗斯仍然完全依赖美国的零部件。一些受制裁的俄罗斯银行的卡片不再支持苹果支付或谷歌支付，导致2月28日莫斯科地铁因乘客无法刷手机入闸而一片混乱。

俄罗斯金融市场的混乱就更令人吃惊了。毕竟，俄罗斯到2022年已经坐拥价值6300亿美元的国际储备（约相当于GDP的40%），达到有史以来的最高水平，而且也降低了储备中美元的份额。自2014年以来，俄罗斯还大幅减少了对外国的外币债务。

但是该国仍然依赖外国投资者。外资在俄持有的短期资产（包括银行贷款和股票）相对于GDP的比例与在其他新兴市场一样高，而且自2014年以来一直保持稳定。即使没有制裁，随着投资者急忙撤离，俄罗斯资产也将面临巨大压力。

而俄罗斯一直认为自己有能力获取外汇来捍卫卢布。制裁并未完全切断外汇来源：俄罗斯能源出口基本上不受西方禁令影响，因此仍有部分美元流

入。但是由于制裁，俄罗斯65%的外汇储备可能实际上一文不值。其余35%的储备是黄金和人民币，但无法用来在美元和欧元市场上捍卫卢布。

随着时间的推移，俄罗斯的困境只会加剧。被踢出SWIFT金融转账系统将损害贸易，毕竟俄罗斯推动的旨在取代SWIFT的SPFS（金融信息传输系统）还远不如SWIFT普及。三分之一的俄罗斯进口商品仍需用美元支付，在美元突然难以获得的情况下就成了一个问题。即使是从中国进口的商品，在“去美元化”取得一定进展后，仍有约60%的交易使用美元。

| 上帝的考验

问题是普京是否真在意这一切。他也许不会想要面对愤怒的寡头——如果他们当中真有人敢出声的话。但是，希尔和盖狄在书中展示，普京主义的核心信条是生存主义，这种理念将经济战争视为一场耐力测试。痛苦恰是它的标志物。“在这套叙事中，俄罗斯一直在与充满敌意的外部世界作战以求生存。”他们说。“一个重要的历史经验是，俄罗斯这个国家总能以某种形式生存下来。”俄罗斯面临深度衰退。但是，普京可能非但不会让步，还会加倍用劲要让俄罗斯与世隔绝。■



The Citi that was never finished

Citigroup is disposing of its international retail network

The sale marks the end of a remarkable experiment in global finance

THE “DILLY-DALLYING”, to use the term put forward by Jane Fraser soon after taking over Citigroup in early 2021, is almost over. Outside America and a few international centres, the distinctive blue branches that were once common features of big cities around the world will soon be vestiges of another era, much like black, yellow and red Kodak signs. The New York-based bank, which built a reputation over decades as a global consumer giant, is in retreat. From now on it will focus primarily on commercial banking and wealth management, serving large and medium-sized businesses and millionaires. The retail branches it retains will mostly be concentrated in a few domestic markets, such as New York and California.

A series of announcements have already been made: in August the sale of the Australian retail operations to National Australia Bank; in October the wind-down of those in South Korea; in December the sale of its Philippine business to UnionBank of the Philippines; in January a disposal of Indonesian, Malaysian, Thai and Vietnamese branches to Singapore’s United Overseas Bank (UOB), whose chief executive, Wee Ee Cheong, remarked that in a single deal his institution had added what it had taken “even Citi” half a century to build; and, also in January, the sale of Citi’s consumer business in Taiwan to DBS, another Singaporean bank.

The remaining announcements are expected to come soon. One of the most important will be about India, where Citi has long had an outsized influence; Axis Bank, India’s third-largest private-sector lender, is rumoured to be close to picking up the business for around \$2.5bn. Operations in China, Russia, Poland and Bahrain are still in play. Added to the disposal list recently has been the wholly owned Banamex, Mexico’s

third-largest bank. Delay would only erode whatever value remains in these operations as employees and customers look for a stable home.

Citi's retreat is not unique. HSBC, which came closest to having Citi-like global ambitions in retail banking, has pared back—though not as dramatically, at least in part because its core market, Hong Kong, is much smaller than Citi's. Australia's ANZ gave up on a pan-Asia strategy six years ago. Like Citi, these banks have kept offices around the world for corporate business, from lending to treasury services.

As a result, it is tempting to view Citi's retreat as just another failed attempt at world domination in consumer banking. But it differs from past failures in two respects: the sheer ambition behind the initial expansion, and the legacy it leaves in retail-banking markets around the world.

| *Important to Reed*

The expansion was premised on rethinking global finance, with a vast network serving everyone, everywhere, in every way. As with many ambitious plans, Citi's global push was in response to problems at home. In the 1970s, regulatory restraints resulted in a retail-branch network that was limited to New York City, unprofitable and unable to provide the funds Citi wanted for its lending business. While on holiday, John Reed, a senior executive, wrote a seven-page "memo from the beach" arguing that one option would be for Citi to dump retail banking altogether, a path later taken by Bankers Trust (now part of Deutsche Bank), Bank of New York and Boston's State Street, among other institutions. The other option was to go very big.

Mr Reed posited that rather than thinking about retail banking as deposits and loans, Citi should answer the expansive financial needs of families, whatever they may be. Through "success transfer", as the bank dubbed it, solutions developed in one market could be rolled out in others, creating

economies of scale where they would not exist in a self-contained local institution. The bank came up with a clever slogan to fit: “Citi Never Sleeps”.

Years of heavy losses were incurred to create a new form of retail banking, components of which are now so familiar that it is hard to imagine they once didn't exist. These included ATMs (Citi was the first big American bank to introduce customer-friendly machines at scale), credit cards (of which it went on to become the world's largest issuer) and electronic payments (which it was one to the first to offer to retail customers).

Citi's reputation as a driving force in financial technology stretched into the 1990s, when more than a million customers received floppy disks biannually with software updates, enabling proto-internet banking. Aware of the identification challenge that existed in a transition from human contact in branches, the bank experimented with the retina-scanning technology that, along with facial recognition, is only now becoming common.

These innovations helped drive international expansion. Mr Reed became the bank's chief executive in 1984 and an ever-wider array of markets were opened, extending from Nigeria and Sweden to (via a Hong Kong acquisition) Thailand, as well as particularly swanky efforts in London and Geneva. The bank opened a representative office in Beijing, too. Augmenting the branches were call, processing and innovation centres in numerous places, including Silicon Valley, the Philippines and perhaps most importantly India, where they played a critical role in germinating the country's vibrant technology-outsourcing industry.

The bank's drive was a magnet for bright people. Alumni included a former prime minister and the current finance minister of Pakistan, a former central-bank governor of the Philippines and the future leaders of

innumerable financial institutions, including the largest private-sector bank in India in terms of assets, HDFC Bank—whose market capitalisation alone is more than 90% of Citi’s—and DBS, whose present chief executive came to the bank after being a star at Citi.

In many ways this reflected Citi’s success but it also illustrated its vulnerability. “Success transfer” ultimately meant creating capable competitors. Local regulators created their own obstacles, limiting the rights of foreign banks to open branches or link international accounts, thereby undermining economies of scale. Technological innovation dimmed after Mr Reed’s departure in 2000. Rivals, including those run by former Citibankers, copied Citi’s innovations, sometimes improving on them or offering them more cheaply.

Then came the global financial crisis in 2007. After incurring huge losses on over \$300bn of risky assets, Citi required a bail-out—revealing that, in a pinch, it was an American, not global, institution. This was underscored by stringent new domestic regulations complicating, when not blocking, international transactions.

That began a long period of contraction. Early to go was the German retail operation, for \$7.7bn, then others in Turkey, Brazil, Egypt and over a dozen other countries. It was as if the United Nations of banking was being unwound. The Asian and Mexican operations remained, each in different ways offering much potential. But Ms Fraser, who joined the bank in 2004 and was less tied to the old strategy, concluded that the bank lacked the scale needed to compete in many of its markets.

A striking feature of the final reckoning has been how little the Asian operations really mattered to Citi’s results. Their presence vastly exceeded their financial relevance: the Asian businesses that are being sold accounted for only 1.6% of group earnings in 2021. This helps explain the

paucity of bidders. None of the businesses have been bought by Standard Chartered or HSBC, and their own far-reaching operations are now questioned. Years ago JPMorgan Chase's boss, Jamie Dimon, formerly of Citi, considered replicating its global network, only to conclude that building a retail business market by market wasn't viable. It is also striking that Chinese banks, the new Goliaths, have made barely any effort to build foreign retail operations.

Buyers of Citi's Asian assets, to the extent they have emerged, are fully or somewhat local. True, Singapore's DBS and UOB have been willing to acquire abroad, but Taiwan and Vietnam are hardly far-flung, especially for banks whose home market is small and serves as a hub for Asian finance. Local and regional consolidation would seem to be more reflective of the times.

| *Systemic rewards*

As Ms Fraser pushes on with the dismantlement, there will doubtless be gnashing of teeth within an institution that looks to many outsiders like a shadow of its former self. It may be some consolation to current and former Citibankers that the technological components of Mr Reed's vision have been taken up both through interlinkages in the global financial system—ATMs and credit cards have long been ubiquitous—and through fintech operators such as Grab in Singapore, Ant Group in China and Wise in Britain, that enable electronic payments and remittances. Citi's experience, in short, suggests that the benefits of globalised finance can be more easily enjoyed by the system as a whole than by any single institution.

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花旗壮志未酬

花旗集团正在割弃其国际零售网络

此次抛售标志着全球金融业一场非凡的实验结束了

“磨磨蹭蹭”，简·弗雷泽（Jane Fraser）在2021年初接管花旗集团后不久用这个词来形容当时的状况。如今这样的阶段行将结束。花旗分行那独特的蓝色标牌曾经是世界各大城市的共同特征，但在除美国和几个国际中心城市以外，它们将很快成为另一个时代的遗迹，就像黑、黄、红三色的柯达标识那样。过去几十年里，这家总部位于纽约的银行树立起了全球消费金融巨头的声名，而现在它正在回撤。今后它将主要专注于商业银行业务和财富管理，为大中型企业和百万富翁服务。它保留的零售分支将主要集中在纽约和加州等几个国内市场。

花旗已经发布了一系列公告：去年8月将它在澳大利亚的零售业务出售给澳大利亚国民银行（National Australia Bank）；10月表示将逐渐退出在韩国的零售业务；12月把菲律宾业务出售给菲律宾联合银行

（UnionBank）；今年1月，把印尼、马来西亚、泰国和越南的分支机构卖给了新加坡大华银行（UOB）。大华银行总裁黄一宗表示，只靠这一笔交易，大华银行就拿到了“即便是花旗”也花了半个世纪才建立起来的业务网络；同样在1月，花旗将它在台湾的消费者业务出售给了另一家新加坡银行星展银行（DBS）。

其余的公告预计很快会发布。其中最重要的一条将与印度有关，花旗长期以来在印度拥有巨大的影响力。有传言称，印度第三大私营银行Axis Bank已接近以约25亿美元收购花旗在印度的零售业务。在中国、俄罗斯、波兰和巴林的业务仍在运转。不久前，花旗全资拥有的墨西哥第三大银行Banamex也加入了出售名单。不管这些业务还剩多少价值，拖延只会侵蚀价值，因为员工和客户都在寻找更安稳的去处。

花旗的撤退并非个例。在全球布局零售业务的抱负上曾经最接近花旗的汇丰银行已经缩减了规模，不过动作没有花旗大，主要原因之一是它的核心

市场香港要比花旗的核心市场小得多。澳大利亚的澳新银行（ANZ）六年前放弃了泛亚战略。和花旗一样，这些银行在世界各地保留了贷款和司库服务等面向企业的分支机构。

因此，人们很容易把花旗的撤退看成是又一个企图统领全球消费银行业务的尝试落空了。但它在两个方面不同于以往的失败：一是它最初的扩张背后的十足雄心，二是它在全球零售银行市场留下的遗产。

| 里德备忘录

花旗此前的扩张建基于对全球金融的重新思考——要拥有一个庞大的网络，从方方面面服务世界各地的每一个人。和许多雄心勃勃的计划一样，花旗的全球扩张是它面对国内困境时的一种对策。上世纪70年代，由于监管限制，花旗的零售分支网络只局限于纽约市，不仅赚不到钱，也无法为它的贷款业务提供所需的资金。高管约翰·里德（John Reed）在度假时写下了七页“来自海滩的备忘录”。他认为花旗有两条路可选：一是把零售银行业务整个抛弃，这条路后来被信孚银行（Bankers Trust，现在并入了德意志银行）、纽约银行以及波士顿的道富银行（State Street）等其他金融机构采用；另一条路是把规模变得非常之大。

里德认为，花旗不应将零售业务仅视为存款和贷款，而应满足千家万户全面的金融需求，无论会包括什么样的需求。通过花旗所谓的“成功转移”，在一个市场开发出来的解决方案可以应用到其他市场，创造出在独门独户的地方金融机构中不会具有的规模经济。花旗给这种战略搭配了一句巧妙的广告语：“花旗从不歇息”。

花旗承受了多年的巨额亏损来创建一种新型零售银行业务，其中一些是现在司空见惯的服务，很难想象它们原本不曾存在。这其中包括自动取款机（花旗是美国第一家大规模推出方便客户的ATM机的大型银行）、信用卡（花旗后来成为世界上最大的信用卡发行机构）和电子支付（它是美国第一家向零售客户提供电子支付的银行）。

花旗推动金融科技发展的名声一直延续到上世纪90年代，当时超过一百万

花旗客户每半年就会收到一次供软件升级的软盘，这是互联网银行业务的雏形。花旗意识到，其分支机构在从人工服务转型的过程中都存在着身份识别的难题，于是它尝试使用视网膜扫描技术，而这项技术以及面部识别技术直到现在才广泛普及。

这些创新助力了花旗的国际扩张。1984年里德出任CEO后，花旗打开了越来越广阔的市场，从尼日利亚、瑞典，到通过在香港的一项收购进入泰国，此外还尤其高调地打入了伦敦和日内瓦。花旗也在北京开设了代表处。支持这些分支机构的是在硅谷、菲律宾等很多地方设立的呼叫、处理及创新中心，其中最重要的或许在印度——它们在催生印度蓬勃发展的技术外包产业上发挥了至关重要的作用。

花旗的干劲吸引来了很多人才。它的前雇员中出了巴基斯坦的前总理、现任财政部长、菲律宾前央行行长，以及数不胜数的金融机构的领导人，这些机构包括以资产计印度最大的私营银行HDFC Bank——它一家的市值已达到花旗的90%以上。还有星展银行，它的现任CEO就是在成为了花旗的明星人物后转去了星展。

这在许多方面反映了花旗的成功，却也透露出它的脆弱性。“成功转移”最终制造出了强有力的竞争对手。地方监管机构也设置障碍，限制外资银行开设分支机构或者开展与国际账户相关的业务，破坏了它的规模经济。2000年里德离开花旗，技术创新从此黯然失色。一众竞争对手复制了花旗的创新，包括那些由花旗前高管执掌的对手。它们有时对这些创新做些改进，或以更低的价格提供相关服务。

接下来2007年全球金融危机爆发。在逾3000亿美元的风险资产出现巨额亏损后，花旗请求政府纾困——这表明，在紧要关头，它还是一家美国银行，而不是全球性银行。美国国内出台的严格的金融业新法规更是凸显了这一点，它们虽然没有禁止国际交易，但也让这类交易变得更麻烦复杂了。

这开启了一段很长的收缩期。首当其冲的是花旗在德国的零售业务，以77

亿美元的价格出售；然后是在土耳其、巴西、埃及和其他十多个国家的业务。这就好像是银行业的联合国在解体。在亚洲和墨西哥的业务保留了下来，以其各自的方式展现出很大的潜力。但是，2004年加入花旗、不太受旧战略束缚的弗雷泽总结认为，花旗在自己的许多市场都缺乏竞争所需的规模。

最终盘点下来的一个惊人发现是亚洲业务对花旗的业绩实际上无足轻重。它们铺开的规模远远超过了财务上的贡献：目前正在出售的亚洲业务仅占2021年集团盈利的1.6%。这有助于说明为何竞标者寥寥无几。渣打银行和汇丰银行都没有收购其中任何一项业务，而它们自己铺开的大摊子现在也受到了质疑。几年前，担任过花旗CEO的摩根大通老板杰米·戴蒙

（Jamie Dimon）曾经考虑复制花旗的全球网络，最后却得出结论：一个市场接一个市场地建立零售业务并不可行。同样引人注目的是，作为新晋巨头，中国的银行在建立外国零售业务方面几乎没有任何动作。

就目前已经亮相的花旗亚洲资产的买家来看，它们都是完全的或一定程度上的本土企业。诚然，新加坡的星展银行和大华银行一直乐于做海外收购，但台湾和越南并不遥远，尤其是对于本土市场规模小、同时又处于亚洲金融中心的新加坡的银行而言。本土和区域性的整合似乎更符合当下的潮流。

| 系统性奖励

在弗雷泽努力推进拆解花旗之时，在这家很多外人看来已经大不如前的银行的内部，必定会有人心有不甘。或许能让现在和过去的花旗人聊以自慰的是，里德愿景中的技术构件已经为这个世界所用，一方面是通过全球金融系统的互通互联——ATM机和信用卡早已无处不在，一方面是通过诸如新加坡的Grab、中国的蚂蚁集团和英国的Wise等金融科技运营商实现电子支付和汇款。简而言之，花旗的经验表明，更容易享受到金融全球化的好处的是整个金融系统，而不是哪一家金融机构。





The bear's market

Western sanctions have rocked Russia's financial system

But the damage so far pales in comparison with the financial crisis of 1998

THE SANCTIONS are unprecedented, but the results are grimly familiar. After Western countries froze Russia's central-bank reserves and banned some of its banks from SWIFT, a payment network, the prices of Russian assets plummeted.

The steep sell-off represented the country's fourth financial crisis in 25 years. In 1998 Russia defaulted on its debt and stopped propping up its currency. A decade later, amid a global financial crisis, Vladimir Putin ordered the invasion of Georgia. And in 2014 investors fled Russia again, following his annexation of Crimea.

Since Mr Putin began massing forces on Ukraine's border, the rouble has lost 33% of its value against the dollar. The currency has fallen faster than in 2008 and 2014, although its decline so far is not as large as that of 2014. Russia's financial woes are not yet as severe as in 1998, when the rouble plunged by 70%. But another debt default could be similarly devastating.

Mr Putin has spent years preparing for a financial stand-off with the West. Since 2015 the value of Russia's central-bank reserves has risen by 71%, with most of the increase in the form of gold or Chinese yuan. The bank has also cut the share of its reserves held in America and France. Nonetheless, 70% remain in countries that are imposing sanctions, limiting Russia's ability to support the rouble. Had the government not forced exporters to sell 80% of their foreign currency and banned foreigners from selling Russian assets, the rouble would have weakened even more.

The only silver lining for Russia is that the prices of its commodity exports

have surged. European governments carved out energy sales from the sanctions, letting customers continue buying natural gas—whose spot price has more than doubled—from Russia. Revenue from oil and gas funded a third of Russia's government budget in 2021, enough for two years of military spending at the pre-war rate.

In theory, energy firms should benefit from higher prices. Russia's stockmarket has been closed this week. However, the value of the London-listed shares of four Russian oil and gas companies, whose domestic shares jointly make up a third of the Moscow exchange's market capitalisation, fell by 97% before trading was suspended. Even if these firms do reap a windfall, investors do not expect it to wind up lining the pockets of foreign shareholders.

Sources: Bloomberg; Bank of Russia; Haver Analytics; The Economist ■



“熊”市

西方制裁撼动了俄罗斯金融体系

但至今损伤还远不及1998年金融危机

如今俄罗斯受到的制裁是空前的，但结果之惨烈世人并不陌生。在西方国家冻结俄罗斯央行的储备资产并将该国部分银行逐出SWIFT国际结算系统后，俄罗斯的资产价格暴跌。

此次市场急剧抛售是俄罗斯25年来的第四次金融危机。1998年，俄罗斯国债违约并放任卢布贬值。十年后，在全球金融危机期间，普京下令入侵格鲁吉亚。2014年，普京吞并克里米亚后，投资者再次逃离俄罗斯。

自普京在乌克兰边境集结军队以来，卢布兑美元汇率已下跌33%。这次卢布贬值的速度比2008年和2014年时都要快，但至今跌幅仍低于2014年。俄罗斯这次金融危机还不至于像1998年时那样严重，当时卢布暴跌了70%。但这次如果再出现债务违约，局面可能会同样惨不忍睹。

多年来，普京一直在着手准备与西方展开金融对峙。自2015年以来，俄罗斯央行的储备价值上升了71%，其增长大部分来自黄金或人民币资产。该银行同时减少了放在美国和法国的外汇储备比重。尽管如此，70%的储备还是在当前对俄实施制裁的国家境内，俄罗斯支撑卢布的能力因而受制。如果不是俄政府强迫出口商出售80%的外汇并禁止外国人出售俄罗斯资产，卢布还会更加疲软。

俄罗斯唯一的慰藉是其大宗商品的出口价格已经飙升。欧洲各国政府把能源贸易排除在制裁范围之外，所以俄罗斯的能源客户可以继续从该国购入天然气，而天然气现货价格已经翻了一番多。2021年，石油和天然气收入为俄罗斯政府的财政预算贡献了三分之一的资金，足够应付两年的军事开支（按战前水平计算）。

理论上，能源企业会因价格飙升而获利。上周起俄罗斯股市一直关闭。然

而，四家俄罗斯石油和天然气企业（在俄罗斯国内的股票共占莫斯科交易所总市值的三分之一）在伦敦上市的股票在停牌前跌幅达到97%。即使这些企业趁机大发横财，投资者也不指望这会肥了外国股东的口袋。

资料来源：彭博；俄罗斯央行；Haver Analytics；《经济学人》 ■



Reverse gear

Porsche and Volkswagen are set to uncouple—at last

A flotation will end an uneasy relationship

PURCHASING A NEW Porsche often involves a long wait. If limited production and aloof dealers weren't enough of a bottleneck, some buyers face further delays after a fire that broke out last month mid-Atlantic on a ship carrying 4,000 vehicles, including Porsches, from the stable of brands owned by Volkswagen (VW).

As with Porsches, so, too, with Porsche the company. Talk of letting investors buy a slice of the illustrious sports-car maker has been in the air almost ever since it combined with VW after Porsche's audacious attempt to take over the much larger German company in 2008. That misadventure brought Porsche close to bankruptcy, averted thanks to a rescue by VW. One upshot of the affair was for the Porsche brand to become VW's wholly owned subsidiary in 2012. Another was that the holding company controlled by the secretive Porsche and Piëch families, descendants of the sports-car maker's founders, became VW's largest shareholder.

A parting of the ways now looks closer than ever. On February 22nd VW and the families' holding company said they were in "advanced discussions" over an initial public offering (IPO) of Porsche.

For VW's boss, Herbert Diess, the spin-off could not come soon enough. He has been trying to streamline VW's unwieldy collection of ten distinct marques. Dealing with flashy Porsche, which has always regarded itself as a cut above the rest of the group, is a headache he can do without. Porsche insisted, for example, on developing its own platform to underpin electric models rather than cutting costs by sharing one with the group's other brands.

An IPO would also raise cash for Mr Diess to plough into his reinvention of VW as a maker of software-intensive electric vehicles. Manufacturers of upmarket cars have looked enviously at Ferrari since its flotation in 2015. The Italian firm's stockmarket value has doubled in three years, to €35bn (\$40bn). It is valued more richly, relative to earnings, than the luxury-goods firms it sought to match—let alone than lowly carmakers. (The family holding company of Ferrari's chairman owns part of The Economist's parent company.)

Porsche is no Ferrari. Its operating margin of over 15% is well below the Italian company's 25% or so. But it handily outperforms the rest of VW. Despite making only 277,000 of the 11m vehicles that the group turned out in 2019, before the pandemic and the ensuing chip crunch, it accounted for a tenth of the group's revenues and a quarter of its operating profit. The Taycan, a battery-powered model, shows it has a clear and profitable strategy for electrification that most other sports-car firms lack. Philippe Houchois of Jefferies, a bank, reckons that Porsche is worth €60bn-90bn. That is more than half of VW's current market capitalisation of €109bn.

And the Porsche and Piëch families? By some estimates their members would now be twice as rich had they not attempted the abortive takeover in 2008. And their holding company will need to raise money to buy Porsche stock, perhaps by selling some of their VW shares. But, as Mr Houchois points out, they would at least reclaim a more direct stake in the firm that bears the family name. Perhaps that is what they have been waiting for.

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挂倒档

保时捷和大众总算要分开了

上市将结束一段别扭的关系

买一辆新的保时捷通常要等很久。如果说有限的产量和无动于衷的经销商还不够让人等的话，一些买家还要面临更久的延误：上月，大西洋上的一艘船发生火灾，船上载有4000辆大众旗下品牌汽车，其中就有保时捷。

保时捷不好买，保时捷公司也一样。2008年，保时捷大胆出击收购规模比自己大得多的德国公司大众，最后与之合并。自那以后，关于投资者将能持股保时捷的消息几乎就没断过。那次收购失败让这家卓越的跑车制造商落得几近破产，反过来要靠大众出手相救才得以幸免。收购风波的一个结果是保时捷品牌在2012年变成了大众的全资子公司。另一个结果是由神秘的保时捷家族和皮耶希家族控制的控股公司成为了大众最大的股东，这两个家族都是保时捷创始人的后代。

现在，看起来双方比任何时候都接近各奔前程了。2月22日，大众和两个家族的控股公司表示，他们已就保时捷IPO进入“深入讨论”阶段。

对于大众老板赫伯特·迪斯（Herbert Diess）来说，这样的分拆来得再及时不过。他一直试图精简大众足足有十个不同品牌的庞大阵容。保时捷一直都自视高队友一等，迪斯对浮华的保时捷很是头疼，巴不得不管它。例如，保时捷坚持要开发自己的电动汽车平台，不想通过与集团其他品牌共用平台来削减成本。

IPO还将让迪斯筹集到资金，助力他把大众重塑为一家软件密集型的电动汽车制造商。自2015年法拉利上市以来，高端汽车制造商都对它羡慕不已。这家意大利公司的市值在三年内翻了一番，达到350亿欧元（400亿美元）。它的市盈率比它试图看齐的奢侈品公司更高，更不用说跟低端汽车制造商比了。（法拉利董事长的家族控股公司拥有本刊母公司的部分股份。）

保时捷不是法拉利。它的营业利润率超过15%，远低于法拉利25%左右的数字。但它的业绩轻松超越了大众旗下其他品牌。在疫情和随后的芯片紧缺发生前，大众2019年生产的1100万辆汽车中只有27.7万辆是保时捷，但它贡献了集团收入的十分之一和营业利润的四分之一。从电池驱动的车型Taycan看，保时捷有一个清晰且有利可图的电气化战略，而这是其他跑车公司大多欠缺的。杰富瑞银行的菲利普·乌锡瓦（Philippe Houchois）估算保时捷的价值在600亿到900亿欧元。这相当于大众目前1090亿欧元市值的一半以上。

那保时捷和皮耶希家族呢？根据一些估计，如果他们没有在2008年尝试那次终告流产的收购，其成员的财富会比现在多一倍。他们的控股公司将需要筹集资金来购买保时捷的股票，可能是通过出售一部分大众股票。但是，正如乌锡瓦所指出的，他们至少会重新直接持有冠有家族之名的公司的股份。也许他们一直等的就是这个。





Industrial policy

Midwestern states want to become “hard-tech” hubs

Putting their money where their machines are

THE ENTRANCE of MHub, a tech “incubator” in Chicago, resembles similar outfits elsewhere. There is a bar made from disused silicon chips, complete with a vintage arcade games machine, a foosball table and a pool table. Much like other tech incubators, there is also nobody around taking advantage of them, as covid-19 has reduced the appeal of socialising with lots of colleagues. To find out what is different about MHub, you have to go farther inside. At the back there is a fully equipped workshop. Three CNC milling machines, which cut aluminium into computer-designed shapes, hum away. There are devices which inject plastic into moulds; ones which print silicon chips; 3D printers; and a CT machine to scan prototypes. Unlike the toys in the games room, they are in use. Engineers scurry around clutching parts.

MHub, founded in 2017 in a building that once housed a Motorola design lab, is the world’s first “hard tech” incubator, at least according to its CEO, Haven Allen. The business model works much like tech incubators elsewhere. Startups are invited to apply to join through a competition. The winners are given mentoring, two years of access to the space and \$75,000 in cash. MHub takes a chunk of equity, hoping to get its money back when the firms succeed. Unlike incubators elsewhere, however, which are devoted to finding brilliant app designers, at MHub only people with physical products to sell are considered. It is in Chicago so that successful applicants can “leverage” access to manufacturers across the Midwest, says Mr Allen.

MHub taps into the dreams of a lot of government types and business folk across the region that they might yet turn the rustbelt into something more

glamorous—a “Silicon Heartland”. The idea is that the Midwest has a huge amount of manufacturing expertise in an era when tech firms increasingly need it.

“We know how to make things and make things happen in Michigan,” says Garlin Gilchrist, the lieutenant-governor of Michigan, a former software engineer who returned from the West Coast. “We’re just beginning to write our future,” says Penny Pritzker, a Chicago-based billionaire who was commerce secretary under Barack Obama. But for much of the past 60 years, the Great Lakes economic region (which also includes Indiana, Ohio and Wisconsin) has struggled. The manufacturing industry, which still makes up 15-20% of GDP in most of those states, has grown more slowly than services.

Can “hard tech” really reverse that? There are some reasons to be hopeful. In January Intel, a chipmaking giant, announced plans to invest \$20bn in a new factory near Columbus, Ohio, which the firm said could become “the largest silicon manufacturing location on the planet”. General Motors has announced that it is investing \$7bn in Michigan in high-tech car manufacturing, including a battery plant near Lansing. In Chicago, funding for startups more than doubled in 2021, to about \$7bn for the year.

According to Mark Muro of the Brookings Institution, a think-tank, a highly competitive manufacturing base could promote future growth for the region. “If it survived 25 years or more of hyper-globalisation and offshoring, what is left is pretty strong,” he says. That sort of high-tech manufacturing—particularly of cars, but also of medical equipment and drugs—tends to require both engineering and software-development talent. As it happens, the region’s universities already provide a ready supply of both. But in the past “a lot of that talent has wound up in Silicon Valley,” Mr Muro says.

One of the reasons why growth has been so sustained in big, densely populated places like New York and the San Francisco Bay Area is that tech firms like to be near other tech firms, so as to be able to poach talent. The “agglomeration” benefits are such that they are willing to pay even the outsize salaries workers in such regions can demand. That in turn has sucked away workers and capital from the interior. But if tech firms are starting to make more physical stuff, they need to be closer to factories—which the coasts have relatively few of, and the Midwest has aplenty. The competition to become the world’s leading internet software-developing region is “over, it’s happened”, says Chris Gladwin, a serial tech entrepreneur based in Chicago. But a new, wider boom may be starting.

Making sure it actually comes to the Midwest may take more than states are capable of doing on their own. To attract Intel, Ohio offered around \$2.1bn in incentives, including grants and tax breaks. GM’s investment in Michigan came with around \$800m. But cash alone cannot create the conditions for sustained growth, says Brad Henderson of P33, a Chicago organisation which connects firms to universities. Subsidies may merely move around investment that would have happened anyway.

Instead, sparking a boom will require deep co-operation and federal investment. A package of \$250bn aimed at improving America’s competitiveness with China by investing in high-tech manufacturing is working its way through Congress. To reverse decades of relative decline is a tall order. But Americans are buying more stuff, and supply-chain jams have caused shortages of everything from silicon chips to lumber. If the Midwest is to catch up, its boosters believe it needs to take its chances now, before they begin to fade again. ■



产业政策

中西部各州有志成为“硬科技”中心

在机器所在地砸钱

芝加哥的科技“孵化器”MHub的入口与别处的同类公司很像。一个废弃硅片制成的吧台，搭配一台老式街机游戏机、一台桌上足球机和一张台球桌。也和在其他科技孵化器看到的差不多，它们目前无人光顾，冷冷清清，因为疫情已经减少了与大堆同事社交的吸引力。想了解MHub有何不同，你得深入内部。走到它的后方就看到了一个设备齐全的车间。三台数控铣床嗡嗡作响，把铝切割成计算机设计的形状。还有把塑料注入模具的设备、打印硅芯片的设备、3D打印机和一台扫描原型的CT机。不同于游戏室里的那些玩具，这些机器都在使用中。工程师们拽着零件四下奔走。

2017年，MHub在一个摩托罗拉设计实验室的旧址上成立，是世界上首个“硬科技”孵化器——至少这是CEO哈文·艾伦（Haven Allen）的说法。它的商业模式与其他地方的科技孵化器很相似。创业公司受邀通过一项比赛申请加入。获胜者将获得指导、两年的空间使用权，以及7.5万美元的现金。MHub持有很大一部分股权，以期在这些公司成功时收回投资。然而，其他地方的孵化器致力于寻找优秀的应用设计师，而MHub只考虑有实体产品可供销售的人。艾伦说，MHub位于芝加哥，所以成功的申请者可以“充分利用”整个中西部的制造商资源。

MHub迎合了中西部地区许多政府官员和商界人士的梦想，他们希望自己仍有可能把工业锈带变成一个更光鲜的所在——可以称之为“硅心”。其理念是，在科技公司愈发需要制造能力的时代，中西部刚好拥有储备巨大的专业制造技能。

密歇根州副州长加林·吉尔克里斯特（Garlin Gilchrist）说：“在密歇根，我们知道如何制造产品、创造奇迹。”他曾在西海岸担任软件工程师。曾在奥巴马政府担任商务部长的芝加哥亿万富翁佩妮·普利茨克（Penny Pritzker）说：“我们刚开始书写我们的未来。”但在过去60年的大部分时间

里，五大湖经济区（也包括印第安纳州、俄亥俄州和威斯康星州）一直处境艰难。这些州的制造业大多仍占GDP的15%到20%，但增速比服务业慢。

“硬科技”真的可以逆转这一局面吗？有一些乐观的理由。芯片制造巨头英特尔在1月宣布计划投资200亿美元在俄亥俄州哥伦布市附近建一家新工厂，英特尔称该工厂可能成为“地球上最大的硅制造基地”。通用汽车已经宣布它正在密歇根州投资70亿美元用于高科技汽车制造，包括在兰辛附近建一座电池厂。在芝加哥，2021年创业公司融资额增加了一倍多，全年约达70亿美元。

智库布鲁金斯学会的马克·穆罗（Mark Muro）称，一个具高度竞争力的制造业基地可以促进该地区的未来发展。他说，“如果它在为期25年或更久的超全球化和离岸外包中幸存了下来，留下来的就是非常强悍的部分。”这种高科技制造业（尤其是汽车制造，但也包括医疗设备和药品）往往既需要工程人才，又需要软件开发人才。恰好，该地区的大学已将两者准备齐全。但在过去，“大批人才都去了硅谷，”穆罗说。

在纽约和旧金山湾区这类人口稠密的大型地区，增长之所以能长久持续的原因之一是科技公司喜欢靠近其他科技公司以便挖掘人才。这种“集聚”效应对它们非常有益，企业甚至愿意为此支付这些地区的员工因此可以要求到的高薪。这继而吸走了内陆地区的工人和资本。但如果科技企业开始制造更多的实体产品，它们就需要离工厂更近——而沿海地区的工厂相对较少，中西部则有很多。成为世界一流的互联网软件开发地区的竞争已经“结束了，已成定局”，现居芝加哥、曾创办多家公司的克里斯·格拉德温（Chris Gladwin）说。但一轮新的、更广泛的繁荣可能正在拉开序幕。

要确保这轮繁荣真正能泽被中西部，只靠各州各自努力恐怕不够。为了吸引英特尔，俄亥俄州提供了约21亿美元的激励措施，包括政府补助和税收减免。通用汽车在密歇根州的投资拿到了地方政府约8亿美元的资助。但仅靠现金无法创造可持续增长的条件，推动校企联合的芝加哥组织P33的布拉德·亨德森（Brad Henderson）表示。补贴可能只是让那些无论如何

都会发生的投资在各地之间流转。

相反，引发繁荣将需要深度合作和联邦投资。一个2500亿美元的提案正在国会推进，它旨在通过投资高科技制造业提高美国的对华竞争力。要扭转几十年来的相对衰落是一项艰巨的任务。但美国人正在购买更多商品，而供应链堵塞已经造成了从硅芯片到木材的各种短缺。如果中西部地区要迎头赶上，其支持者认为它现在就需要抓住机会。机不可失，时不再来。■



Drug manufacturing

BioNTech plans to make vaccines in shipping containers

These standardised factories could be quickly scaled up to expand capacity worldwide

AT THE HEART of its site in Marburg, Germany, BioNTech is putting the finishing touches on a new kind of factory. The drug company has spent eight months reworking its manufacturing processes to produce its mRNA covid-19 vaccine inside a set of standard shipping containers. By creating a modular approach to drug manufacturing, Ugur Sahin, BioNTech's boss, says he aims to transform medicine production around the world.

The work is analogous to software developers rewriting their code to run on different kinds of computer—porting a game from Microsoft's Xbox so that it will run on a Sony PlayStation, for example. Biological porting involves tweaking the 50,000 steps that comprise the manufacturing process of the mRNA vaccine from one environment, BioNTech's existing production lines around the world, so that they work in another, a series of connected, standard metal shipping containers. The firm plans to send its containerised mRNA factories—which it calls Biontainers—to parts of the world which lack their own vaccine-manufacturing capabilities. The first will arrive in an African country, not yet named, towards the end of 2022.

BioNTech has turned to containers as a reliable, repeatable way to achieve “good manufacturing practice” (GMP), a pharmaceutical-industry term for the minimum standards required of a manufacturer as part of their authorisation to sell products. GMP standards exist in order to ensure a consistently high quality of manufacturing output, which in turn protects consumers from badly made drugs. Validating new GMP facilities is a long, slow process. Mr Sahin's aim is to remove, to some extent, local factors from the equation that governs where vaccines can be produced, with a modular GMP facility that can be installed and run anywhere in the world.

All manufacturing operations consist of a series of steps that are known in their entirety only to the collection of engineers who carry out the work, a sort of industrial recipe. This knowledge about the production process includes everything from the settings of dials on every device to the temperatures, pressures and timings at which chemical reactions should run. These variables are precise to the extent that they can change depending on the weather. The transfer of this recipe to new production facilities presents perhaps the greatest bottleneck to increasing vaccine production. Even when pharmaceutical companies were transferring this knowledge internally, during the height of the pandemic, it took around eight months to increase their own vaccine-production capacity.

Mr Sahin wants his shipping containers to speed things up. His idea is that after the process knowledge has been successfully ported into the standardised environment of the shipping container once, that facility can then be quickly cloned into other containers. Updates to the production method or tweaks to the recipe of the vaccine itself could be transmitted digitally to any containers in the network. “This”, says Mr Sahin, “is the future of manufacturing not only for Africa, but worldwide.”

| *Faster, more productive*

After eight months of work to get its first container factory off the ground in Marburg, BioNTech’s approach will be put to the test later this year. By the end of June, Mr Sahin says, the site at its partner country in Africa will be prepared for the arrival of the containers—BioNTech is in discussions with South Africa, Rwanda and Senegal. He expects the containers, the interiors of which will have been set up to the letter in Germany, to have arrived by the end of 2022. Each set of 12 containers will need four or five operators and be capable of producing some 40m-60m doses every year. BioNTech hopes the facility will cost “significantly less” than a traditional vaccine manufacturing factory of equivalent output, which comes with a

price tag of at least \$170m.

The validation and quality-control work will carry on through 2023, as will hiring and training local operators. In parallel, there will be conversations with regulators about the new containerised production process. Mr Sahin says BioNTech is already talking to the African Union, a regional bloc, the Africa Centres for Disease Control and Prevention and national regulators. He hopes that the German and European GMP standards to which the container factories have been built will be acceptable. If they are, then vaccine production will start at the end of 2023.

Although BioNTech's plan will not see any production facilities in operation for almost two years, it also plans for the Biontainers to have utility beyond the pandemic and the production of covid-19 vaccines. Mr Sahin says the production system could be used to make other vaccines and drugs, for example, against malaria or tuberculosis. In July last year BioNTech announced its aim "to develop a well-tolerated and highly effective malaria vaccine and implement sustainable vaccine supply solutions on the African continent".

There may yet be pitfalls in BioNTech's plan. Containers may prove to offer a less uniform manufacturing environment than Mr Sahin hopes. Regulators may spot issues. Countries around the world may not accept medicines produced in facilities which, although geographically local, are operationally under a foreign company's control. But the principle of reducing the cost of copying process knowledge is sound. If it works, Mr Sahin is likely not just to boost manufacturing capacity on the African continent, but to change the way drugs are made everywhere. ■



制药

BioNTech计划在集装箱内生产疫苗

这些标准化工厂可以迅速规模化，扩大全球产能

在位于德国马尔堡（Marburg）的园区的中心，BioNTech正在对一种新型工厂做收尾工作。这家制药公司已经花了八个月的时间改造生产流程，要在一套标准海运集装箱内生产其mRNA新冠疫苗。老板乌尔·萨欣（Ugur Sahin）说，他的目标是创造一种模块化的制药方法，彻底改变全世界的药物生产。

这项工作类似于软件开发人员重写代码，好让它们在不同类型的计算机上运行——例如，从微软的Xbox拿来一款游戏，把它移植到索尼的PlayStation上。生物学上的移植涉及微调mRNA疫苗生产工艺的五万个步骤，从而让它们能从原本的环境（即BioNTech在世界各地的现有生产线）转移到另一个环境（即一系列相互连接的标准金属集装箱）而能如常运作。该公司计划将其集装箱式的mRNA工厂——它称之为“生物集装箱”（Biontainer）——送往世界上自身疫苗生产能力不足的地方。第一批将于2022年底抵达某个非洲国家（具体是哪国尚未透露）。

BioNTech希望集装箱能提供一种可靠且可重复的方法来满足“良好生产规范”（GMP）。GMP是个制药业术语，是制药商申请销售许可的程序中须达到的最低标准。GMP标准的存在是为了确保稳定的高品质生产，从而保护消费者免受劣质药品的危害。认证新的GMP设施是个漫长而缓慢的过程。萨欣的目标是运用一种可以在世界任何地方安装和运营的模块化GMP设施，在一定程度上去除判定哪里可以生产疫苗的方程式中的本地因素。

所有的生产操作都由一系列步骤组成，只有那些执行操作的工程师才完全知道这些步骤，也算是一种行业秘方。这种关于生产流程的知识无所不包，从每个设备上的刻度盘的设置，到应该在什么温度、压力和时机下让化学反应发生。这些变量非常之精确，甚至可能会随天气状况而变化。增加疫苗产量的最大瓶颈可能就在于将这种秘方转移到新的生产设备上。在

疫情最严重的时期，即使制药公司是在内部转移这种知识，也花了大约八个月才提高了自身的疫苗产能。

萨欣希望他的集装箱能帮助提速。他的想法是，一旦工艺流程知识成功移植到集装箱式的标准化环境中，之后就可以将该设施快速克隆到其他集装箱中。生产方法的更新或疫苗配方的微调可以通过数字方式传输到网络中的任何一个集装箱。萨欣说，“这不仅是非洲疫苗制造的未来，也是全世界疫苗制造的未来。”

| 更快、更高效

BioNTech在马尔堡的首个集装箱工厂已经准备了八个月，今年稍晚些时候将启动测试。萨欣说，到6月底，BioNTech在非洲合作国家的工厂将做好准备迎接集装箱的到来——公司正在与南非、卢旺达和塞内加尔商谈。这些集装箱的内部将在德国分毫不差地装配好，萨欣预计它们将会在年底前到达合作国。每套含12个集装箱的设施将需要四五名操作人员，每年能够生产约4000万至6000万剂疫苗。BioNTech希望这套设施的成本将“大大低于”同等产量水平的传统疫苗制造工厂，后者的造价至少要1.7亿美元。

认证和质控工作将持续到2023年，招聘和培训当地操作人员也一样。与此同时，BioNTech还将与当地监管机构沟通新的集装箱化生产工艺。萨欣说，BioNTech已经在与区域集团非洲联盟（African Union）、非洲疾病预防控制中心（Africa Centres for Disease Control and Prevention）和各国监管部门交流。他希望遵循德国和欧洲的GMP标准建造的集装箱工厂能够得到认可。如果获批，疫苗生产将于2023年底开始。

从BioNTech的计划来看，近两年内都不会有任何生产设施投入运营，但是它也计划让“生物集装箱”在疫情过后和生产新冠疫苗之外派上用场。萨欣说，该生产系统可用于制造其他疫苗和药物，比如抗疟疾或结核病的。去年7月，BioNTech宣布要“开发一种耐受性良好且高效的疟疾疫苗，并在非洲大陆实施可持续的疫苗供应解决方案”。

BioNTech的计划可能还是会踩坑。集装箱提供的制造环境可能不如萨欣希

望的那样整齐划一。监管者可能会发现问题。世界各国可能不会接受药品生产设施在地理上是在本地，在操作上却受控于一家外国公司。但是降低复制生产流程知识的成本这一理念是明智的。如果它行得通，萨欣很可能不仅会提高非洲大陆的制药产能，也会改变世界各地的制药方式。■



It is exactly rocket science

SpaceX's monstrous, dirt-cheap Starship may transform space travel

Precisely when, though, remains unclear

WHEN IT COMES to size and spectacle, the peak of the Space Age passed in 1973, with the final flight of the Saturn V rocket that had carried the Apollo astronauts to the moon. Taller than the Statue of Liberty, the Saturn V could lug 140 tonnes into orbit. Its first flight, in 1967, provoked Walter Cronkite, an American news anchor reporting far from the pad, to exclaim: "My God, our building's shaking here!" as ceiling tiles fell around him. Half a century later, nothing as powerful has reached orbit since (see chart 1).

Not far from Boca Chica, a Texan hamlet a couple of miles from the Mexican border, SpaceX, a rocketry firm founded by Elon Musk, is developing a machine that it hopes will change that. Built from gleaming stainless steel, with its nose adorned with fins and ten metres taller than even the Saturn V, Starship looks like something from the cover of a 1950s pulp science-fiction magazine. Its planned payload of up to 150 tonnes means that five Starship flights could put more stuff into space than the rest of the world managed with 135 rocket launches in 2021. Its upper stage contains more pressurised volume than the International Space Station, which took a decade, dozens of launches and perhaps \$100bn to assemble.

But it is not just the size that matters. When a Saturn V took off to send men to the Moon, the only bit of the 2,800 tonnes of hardware which came back was a cramped five-tonne capsule with three men inside. Each new mission meant a new Saturn V. With Starship, the idea is that all the hardware will come back: the massive booster stage almost immediately, the second, orbital stage after fulfilling whatever mission it had been sent on.

At a press event on February 10th to show off an assembled rocket Mr Musk

reiterated his reasons for founding SpaceX: to buy humanity an insurance policy against existential risks by establishing a colony on Mars. Starship is designed to transport the million tonnes of supplies he thinks is needed for that job—roughly 100 times more mass than has been launched since the start of the Space Age. To that end, it is designed to be not only the biggest rocket ever built, but also the cheapest. Existing rockets cost tens to hundreds of millions of dollars per launch (the Saturn V may have cost over \$1bn in today's money). Despite Starship's size, SpaceX hopes to cut that to the low millions.

Mars colonies, if they ever come, remain a long way off. But Starship's unprecedented combination of size and frugality could upend the economics of the space business closer to Earth, too. An industry used to shaving grams of mass and cramming complicated payloads into small cargo bays will see those restrictions lifted. Some scientists are already imagining extravagant space missions that would make full use of the rocket's huge capacity. NASA intends to use it to land astronauts on the Moon; America's soldiers are eyeing it up, too. And Starship is vital to the future of SpaceX itself, which was valued recently at more than \$100bn (see chart 2).

But first the rocket needs to fly. A series of test flights of Starship's upper stage (which, in isolation, is rather confusingly also called "Starship") have ended in crash-landings and explosions. A successful flight came on May 5th last year, when an upper stage flew 10km into the air before landing safely back on its pad. A full-fledged orbital test of the two-stage form of the rocket, with one Starship upper stage sitting atop a Super Heavy booster, had been due in January.

That orbital flight, though, needs approval from regulators, who were deluged with thousands of public comments. Officials have promised a decision within weeks. But broader environmental issues could yet force

the firm to suspend work at Boca Chica entirely. An internal memo leaked last year revealed serious problems with the Raptor engines intended to power Starship. In his press conference, Mr Musk left himself a fair amount of wriggle room. An orbital flight, he said, might come in “a couple of months”—though it could also slip to the end of the year.

| *Zero gravitas*

Something like Starship has been in development at SpaceX for over a decade, under names such as MCT (Mars Colonial Transporter), ITS (Interplanetary Transport System), and BFR (Big Fucking Rocket). Earlier versions were huger still: the ITS had a 300-tonne payload at one point. But all versions had one thing in common: they are designed to be entirely reusable.

SpaceX already flies partially reusable rockets: the first stages of its Falcon 9 machines fly back to Earth under their own power. Once refurbished and refuelled, they can fly again, spreading their construction cost over many launches. But their second stages, which end up much higher and moving at orbital speeds, remain expendable.

With Starship, SpaceX plans to recover both parts. Its Super Heavy first stage, like the Falcon 9's, is designed to fly back to the ground shortly after launch. SpaceX plans to catch it in mid-air with a pair of robotic “chopsticks” attached to the launch tower from which it took off.

Recovering the upper stage requires more drama. Starship will fall belly-first from space, relying on atmospheric drag to shed most of its speed. It will use its stubby fins for control, “rather like how skydivers use their hands and feet”, says Scott Manley, a physicist and programmer who runs a popular rocketry-focused YouTube channel. When it is within a few hundred metres of the ground it will flip itself upright, relight some of its engines and make a rocket-powered landing of its own.

Several test flights have practised this flipping manoeuvre already, though not after a descent from orbit. Mr Musk (whose bold visions sometimes work, and sometimes do not) hopes that each Super Heavy booster could be ready to fly again within an hour. Since the rocket's upper stages would have to complete at least one orbit before returning to Earth, he hopes they might one day manage three flights a day. (The minimum re-use time for a Falcon first stage is about a month.)

Starship's Raptor engines are also designed with reusability in mind, says Mr Manley. They use a sophisticated, highly efficient design pioneered—but never flown—in the Soviet Union in the 1960s. Somewhat unusually, they run on methane rather than kerosene, a more-commonly used rocket fuel. Methane produces very little soot, which helps keep the engine's internals clean—another boon for an engine intended to fly again and again. And both methane and the oxygen necessary to burn it can be made from Mars's thin carbon-dioxide atmosphere with the help of some straightforward industrial chemistry. SpaceX hopes that could, one day, allow Mars-bound Starships to refuel for a return trip to Earth.

But high-level design decisions are not the only reason Starship is cheap. SpaceX has an iterative, rapid-fire, startup-style culture very different from that of older aerospace firms (hence all the crash-landings and explosions). Mr Musk's development philosophy is that "if things are not failing, you aren't innovating enough." In a speech in November to America's National Academies of Sciences, Engineering and Medicine he spoke of running a dozen test flights in 2022. The firm mixes high-tech, bespoke design in some areas (such as the Raptor engines) with a make-do-and-mend attitude elsewhere (some Super Heavy prototypes have fins controlled by electric motors taken from cars made by Tesla, another of Mr Musk's businesses).

One good example is the rocket's stainless-steel construction. Starship was originally going to be built from high-tech carbon-fibre composites, which

are both very strong and very light. But in 2019, despite having produced several big components, SpaceX went back to the drawing board. Carbon composites, it turns out, have several disadvantages. They are porous, fiddly to work with, and need to be cured in an autoclave—not easy when making rocket-body segments that are nine metres across. And, at around \$130 per kilogram, composites are expensive.

Stainless steel, by contrast, is strong but heavy and therefore not an obvious choice for rocket-building. Some steel alloys, though, get significantly stronger as they cool down, meaning less is required for a given strength. And since Starship uses cryogenic propellant, cooling is in abundant supply. Steel is tougher, too, which can save weight elsewhere. SpaceX hopes to get away with applying a heat shield to only the windward part of the upper stage, which feels the full force of re-entry heating, leaving the leeward side as bare metal and saving mass. Stainless steel does not need painting, which reduces weight. It is much easier to work with, and costs mere dollars per kilogram. For a company that intends to mass-produce its rocket, says Simon Potter at BryceTech, a firm of space-industry analysts, that matters.

That may sound like a risky approach when it comes to something as unforgiving as rocket science. But it has served SpaceX well so far. It has pulled off 111 Falcon 9 launches in a row without failure, making it one of the most reliable rockets ever flown. Some Falcon 9 first stages have already been launched ten times.

A cheap, big, reusable rocket has been a dream of space cadets for decades. On paper, at least, Starship fulfils it. “You almost get to a point where launch costs would go away entirely as a consideration,” says Mr Potter. Mr Musk has talked of eventually building a fleet of Starships. If each were indeed launching several times a day, that would give SpaceX the ability to lug a million tonnes of stuff into orbit each year. BryceTech reckons that, in

2021, the world managed 750 tonnes. What you might do with all that capacity (other than supplying a future Mars colony) is another question.

Jonathan McDowell, an astrophysicist and rocket enthusiast at the Harvard-Smithsonian Centre for Astrophysics, notes that Starship's colossal size might go unused in the commercial-satellite market, at least for the foreseeable future. "There just isn't currently a market for large numbers of enormous payloads," he says. SpaceX's Falcon Heavy, with a payload capacity of 64 tonnes, is the most powerful rocket currently flying. Its first launch was in 2018, but it has only flown twice since.

The satellite industry might adapt, in time. In any case, Mr Musk has indicated that Starship, thanks to its cheapness, will replace SpaceX's smaller Falcon rockets, which already have a market share of around 50%. If he sticks to that plan, then early commercial launches of Starship could fly with their holds mostly empty.

| *Congenital optimist*

One medium-term option might be space tourism, says Mr Potter. Existing rockets from Blue Origin or Virgin Galactic can already carry a handful of thrillseekers into space—though not to orbit. Starship could take perhaps 100 people on an orbital trip, or a smaller number even further and in greater luxury.

On February 14th Jared Isaacman, an American billionaire who has already flown into orbit with SpaceX announced that he had ordered three further flights from the firm. The first two will use SpaceX's existing Falcon rockets—but the third, said Mr Isaacman, should mark Starship's first crewed flight. Meanwhile Yusaku Maezawa, a Japanese billionaire, has contracted with SpaceX to send himself and up to a dozen companions on a six-day jaunt around the Moon and back.

Jennifer Heldmann, a planetary scientist at NASA's Ames Research Centre who has written a paper about what Starship could do for science, is more excited. Starship's upper stage is designed to be refuelled in orbit, with extra fuel brought up in the cargo bay of other Starships. A full refill would require several extra flights. But the pay-off, says Dr Heldmann, would be the ability to deposit 100 tonnes or more of cargo on the surface of almost any body in the solar system. (The Perseverance rover that landed on Mars last year had a total mass, with its lander, of about four tonnes.)

Cheap launches might not be immediately revolutionary. Science missions are expensive, and even pricey launches make up only a small chunk of the overall budget. But Dr Heldmann points out that Starship would enable much more ambitious missions, getting scientists more bang for their buck. One option, she says, would be to fly larger quantities of cheaper kit. "All that payload capacity means you could use off-the-shelf components rather than having to custom-make and miniaturise things," she says.

Another option would simply be to go big. Perseverance, which cost \$2.7bn, carries a drill that can excavate a few inches of Martian regolith. Starship, says Dr Heldmann, could carry a full-sized drilling rig that could bore kilometres deep.

And it could also open up access to the outer planets, which have historically been tricky to send missions to. In recent years the watery moons of Saturn and Jupiter have overtaken Mars as the most promising places to search for alien life. One group of scientists has drawn up a plan to use Starship to explore Neptune, which has been visited just once before, in 1989, when the American Voyager 2 probe zoomed by on its way out of the solar system. Such a space craft could weigh tens of tonnes, compared with just 722kg for Voyager 2.

America's government is another potential customer. The country's newly

minted Space Force is looking into Starship for its Rocket Cargo programme, which is designed to explore whether the rocket could be used to deliver equipment rapidly to anywhere on the planet. And with space a vital part of warfighting, America's armed forces would welcome the ability to replenish shot-down satellites quickly and cheaply.

NASA, meanwhile, has chosen a modified version of Starship's upper stage to ferry astronauts to the lunar surface as part of its ambitious Artemis programme. Most of Artemis is designed to use the Space Launch System (SLS), another jumbo-sized rocket that NASA is developing as a successor to the Space Shuttle. But the SLS has a lower cargo capacity than Starship does, and a launch cost projected at \$2bn a time. If Starship works, NASA could come under pressure to scrap the SLS entirely.

SpaceX, for its part, knows exactly what it wants to do with Starship, even before it starts thinking about Mars. Its Starlink project aims to use swarms of thousands of low-flying satellites to beam high-speed internet to anywhere on Earth's surface. Gwynne Shotwell, SpaceX's chief executive, has noted that the global telecommunications market is worth perhaps \$1trn a year. SpaceX thinks it might reasonably aspire to about 3-4% of it.

Because low-flying satellites can see only a small portion of the Earth's surface, Starlink requires enormous numbers of them. The firm already has about 1,655 in orbit, about a third of the total number of active satellites in space. It has permission from American regulators to fly 12,000, and is trying to obtain a licence for 30,000.

But first, SpaceX has to make the rocket work. In his press conference Mr Musk was at pains to play down the probability of the orbital test—when it happens—going smoothly. Even if it did, plenty more testing would be needed before the rocket would be ready to fly real cargo.

Regulatory battles may be looming, too. The firm's Boca Chica facility was built on the understanding that it would be used for the Falcon Heavy, a much smaller rocket than Starship. Explosions from failed flight tests have scattered debris over a wide area, says Mr Manley, while road closures annoy locals. Environmental regulators are reportedly unhappy, and pushing for a full review of the firm's licence. Mr Musk has said that, in the worst case scenario, SpaceX would have to move Starship development to Cape Canaveral in Florida, which would delay things for months.

| *Nervous energy*

Even then, Starship's capabilities could go unused. The true size of the market for Starlink remains unknown. As for his grandest ambition, it is not at all clear how many people would volunteer to live on Mars. The sales pitch, said Mr Musk, is that "it's going to be cramped, dangerous, difficult, very hard work [and] you might die."

Despite the technical challenges ahead, it would take a bold person to bet against SpaceX. In 2008, after the first three launches of its tiny Falcon 1 rocket had failed, the firm almost went under. But the fourth launch worked. The Falcon 9's impressive failure-free run was preceded by more than a dozen unsuccessful attempts to land its first stage. Mr Musk, for his part, is confident. "[Starship] will work," he said. "There'll be a few bumps along the road, but it'll work."

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名副其实的火箭科学

SpaceX巨大而廉价的星舰可能会改变太空旅行

但到底会在何时仍不清楚【深度】

论规模和场面，太空时代的顶峰在1973年就过去了，那一年土星五号（Saturn V）运载火箭的最后一次发射将阿波罗号宇航员送上了月球。土星五号比自由女神像还要高，近地轨道运载能力达到140吨。1967年，美国新闻主播沃尔特·克朗凯特（Walter Cronkite）在一个远离发射台的位置报道土星五号首次发射，天花吊顶面板在他周围掉落，他惊呼，“天呐，我们的楼在晃动！”半个世纪过去了，再也没有那么大威力的火箭进入过近地轨道（见图表1）。

得克萨斯的小村庄博卡奇卡（Boca Chica）与墨西哥边境几英里之遥，在距离该村不远的地方，由马斯克创立的火箭公司SpaceX正在开发一款火箭，希望能改写历史。星舰（Starship）由锃亮的不锈钢制成，火箭头上带有鳍翼，比土星五号还高十米，看起来像是从上世纪50年代通俗科幻杂志封面上飞下来的。它的计划有效载荷高达150吨，意味着它飞五趟太空的送货量就超过了2021年全球135次火箭发射的总送货量。星舰上面级的加压空间比国际空间站还要大，后者可是花了十年时间、数十次发射、可能耗资1000亿美元才组装起来的。

但重要的不仅仅是大小。在送人类上月球时，土星五号发射时硬件总重2800吨，返回地球时仅剩下一个携带三名宇航员的5吨重的狭小太空舱。每发射一次都意味着要新造一个土星五号。星舰的设计理念是回收所有硬件，巨大的助推级几乎马上就回收，二级轨道级在完成任务后回收。

SpaceX在2月10日举行的新闻发布会上展示了组装好的火箭，马斯克在会上重申了他创立SpaceX的初衷，就是通过在火星建立殖民地，为人类购买一份应对生存危机的保险。设计星舰是为了运输建立殖民地所需的补给，马斯克认为需要一百万吨，大约是自太空时代开始以来送入太空的货物总重的100倍。为此设计的星舰不仅是有史以来最大的火箭，也是最便宜

的。现有火箭的单次发射成本从几千万到几亿美元不等（以今天的货币计价土星五号的发射成本可能超过10亿美元）。虽然星舰很大，但SpaceX希望将其发射成本减少到五百万美元以下。

就算真能建立火星殖民地，也还有很长的路要走。但星舰前所未有地把大尺寸和低成本结合起来，也可能颠覆近地轨道太空产业的经济学。多年来，太空产业一直以克为单位减重，把复杂的有效载荷塞进狭小的货舱。未来，这些限制都将不复存在。一些科学家已经在设想如何充分利用星舰巨大的有效载荷完成宏大的太空任务。美国国家航空航天局（NASA）打算用它送宇航员登月；美国军方也看上了它。而星舰对SpaceX自己的未来至关重要，这家公司最近的估值突破了1000亿美元（见图表2）。

但首先这款火箭得能飞起来。星舰的上面级（这个部分本身也叫“星舰”，很容易让人混淆）曾进行了一系列试射，均以坠毁和爆炸告终。去年5月5日试射终于成功，星舰的上面级飞到了距离地面10公里的高度并安全降落在着陆区。对上面级和下面的“超重”助推器（Super Heavy booster）组合以后的全面轨道测试原定于1月进行。

不过，这项轨道测试需要得到监管机构的批准，而监管机构已经收到了成千上万条公众意见。官员承诺在几周内做出决定。但更广泛的环境问题可能会迫使SpaceX完全暂停在博卡奇卡的工作。去年泄露的一份内部备忘显示，将为星舰提供动力的猛禽发动机（Raptor）存在严重问题。在新闻发布会上，马斯克给自己留下了相当大的回旋余地。他说，轨道测试可能会在“两三个月”内进行，不过也可能会推到今年年底。

| 举重若轻

SpaceX开发像星舰这样的系统已经有十多年了，名字五花八门，包括火星殖民运输船（Mars Colonial Transporter，简称MCT）、星际运输系统（Interplanetary Transport System，简称ITS）和超级大火箭（Big Fucking Rocket，简称BFR）。早期的版本尺寸还更大：ITS的最高有效载荷一度达到300吨。但所有系统都有一个共同点：完全可重复使用。

SpaceX已经在发射可部分重复使用的火箭，猎鹰9号火箭的第一级可依靠自己的动力返回地球。这部分在回收翻新和加注燃料之后就可以再次使用，通过多次发射摊薄制造成本。但这些火箭的第二级最终会在高得多的高度以轨道速度飞行，仍然只是一次性的。

对于星舰，SpaceX计划把它的两级都做回收。从设计上来说，与猎鹰9号的第一级一样，星舰的第一级“超重”助推器将在发射后不久即返回地面。SpaceX计划用一对机器臂“筷子”在空中夹住它，这双“筷子”安装在飞船起飞的发射塔上。

回收上面级就需要更多“特技”了。星舰将机腹朝下从太空中落入大气层，依靠大气阻力来大幅减速。它将用其粗短的鳍翼控制姿态，“就和跳伞运动员用手脚调整一样”，物理学家、程序员斯科特·曼利（Scott Manley）说，他在YouTube上开设了一个颇受欢迎的火箭频道。在距离地面几百米时，星舰将自行翻转呈直立状，重新点燃部分引擎，依靠自身动力着陆。

几次试射已经演练过这种转体技巧，尽管不是从轨道上降落的。马斯克（他的大胆设想有时行得通，有时行不通）希望每个“超重”助推器都能在回收后的一小时内准备好再次发射。由于飞船的上面级在返回地球之前必须至少绕轨一周，他希望有朝一日它们可以每天飞三次。（目前猎鹰的第一级最快隔约一个月可重复发射。）

曼利说，星舰的猛禽发动机在设计时也考虑到了回收的问题。他们采用了上世纪60年代由苏联首创（但从未在那里真正起飞）的一种复杂而非常高效的设计。它们使用的燃料是甲烷而不是更常用的煤油，这有点不同寻常。甲烷燃烧时几乎不产生烟尘，这有助于保持发动机内部的清洁，对于打算重复使用的发动机来说是另一个福音。甲烷和燃烧它所需的氧气都可以在火星以二氧化碳为主的稀薄大气层中制成，只需用到一些简单的工业化学手段。SpaceX希望有朝一日这可以让飞往火星的星舰能在返回地球之前补充燃料。

但高级别的设计决策并不是星舰便宜的唯一原因。SpaceX拥有一种迭代、

快速的创业式文化，与以前的航空航天公司截然不同（所以才会有那么多的坠毁和爆炸）。马斯克的开发理念是“如果没有失败，就说明创新不够”。去年11月，他在对美国国家科学院、国家工程院和国家医学院的一次演讲中谈到，将在2022年进行十几次试射。SpaceX在某些方面（例如猛禽发动机）走的是高科技和定制化设计的路子，其他方面则是修修补补凑合用的态度（在一些“超重”助推器原型机上，控制鳍翼的是特斯拉汽车上的电动机，这是马斯克的另一家公司）。

火箭的不锈钢结构就是一个很好的例子。星舰原本要用高科技的碳纤维复合材料来制造，这种材料坚固又轻量。但在2019年，尽管已经生产出了几个大型组件，SpaceX选择从头来过。它发现碳复合材料有几个缺点。它们是多孔结构，处理起来要很小心讲究，而且需要在高压釜中固化——这在建造9米直径的箭体结构时可不容易。而且，碳复合材料价格昂贵，每公斤耗费约130美元。

相比之下，不锈钢坚固但沉重，因此不是造火箭显而易见的选择。不过有些合金钢在冷却时强度会显著增大，这意味着达到一定强度所需的钢材会更少。而由于星舰用的是低温推进剂，这就有了充足的冷却源。钢的韧度也更好，可以在其他地方留出减重空间。SpaceX希望只需在上面级的迎风部分应用隔热罩（这部分再入大气层时会经受全部热量），背风部分的金属则不做任何防护，以节省重量。不锈钢不需要喷漆，这也减轻了重量。它处理起来也容易得多，而且每公斤才几美元。航天工业分析公司BryceTech的西蒙·波特（Simon Potter）说，对于一家打算大规模生产火箭的公司来说，这一点很重要。

对于像火箭科学这样容不得半点差池的事情，这种做法可能听起来很冒险。但到目前为止，SpaceX很成功。它已连续111次成功发射了猎鹰9号，使其成为有史以来最可靠的火箭之一。一些猎鹰9号的第一级已经重复发射了十次。

几十年来，廉价、可重复使用的大型火箭一直是太空人的梦想。星舰至少在理论上实现了它。“甚至到了完全无需考虑发射成本的地步。”波特说。

马斯克曾谈到最终要建造一支星舰舰队。如果每架飞船真能每天发射几次，SpaceX将有能力每年运送100万吨物资到轨道上。BryceTech估计，2021年全球送上近地轨道的物资总共达750吨。这么大的运载能力做什么（除了为未来的火星殖民地供应物资之外）是另一个问题。

哈佛-史密松森天体物理中心（Harvard-Smithsonian Centre for Astrophysics）的天体物理学家、火箭爱好者乔纳森·麦克道威尔（Jonathan McDowell）指出，至少在可预见的未来，巨大的星舰在商业卫星市场上可能不会有用武之地。“对于这样巨大的有效载荷，目前还没有大量需求的市场。”他说。SpaceX的猎鹰重型运载火箭（Falcon Heavy）有64吨的有效载荷，是目前运载能力最大的现役火箭。它在2018年首次发射，但此后只发射了两次。

假以时日，卫星行业的需求可能会有所变化。无论如何，马斯克已表示，由于价格低廉，星舰将取代比它更小的猎鹰火箭，后者已拥有全球约50%的卫星发射市场份额。如果他坚持这个取代计划，那么在早期的商业发射中，星舰的货舱可能基本会是空置的。

| 先天乐观主义者

中期来看，一个选择是太空旅游，波特说。蓝色起源（Blue Origin）或维珍银河（Virgin Galactic）现有的火箭已经可以将少数寻求刺激的人送入太空——不过还不能进入轨道。星舰一次可以携带100人展开轨道旅行，或者可以载更少的人、飞得更远、配置更豪华。

2月14日，已搭乘SpaceX火箭进入过太空轨道的美国亿万富翁贾里德·艾萨克曼（Jared Isaacman）宣布，他向该公司又预定了三次太空之旅。前两次将搭乘SpaceX现有的猎鹰火箭，但第三次，艾萨克曼说，将会是星舰的首次载人飞行。与此同时，日本亿万富翁前泽友作与SpaceX签约，让它送自己和其他最多12名同行者展开六天的地月之旅。

NASA下属艾姆斯研究中心（Ames Research Centre）的行星科学家詹妮弗·赫尔德曼（Jennifer Heldmann）对此更加兴奋，她曾就星舰可以为科

学做些什么贡献写过一篇论文。根据星舰的设计，它的上面级将在轨补充燃料，这些燃料将来自其他星舰的货舱。补充全部燃料将需要另外数个架次的飞船。但赫尔德曼说，这样的好处是将能够向太阳系中几乎任何天体运送100吨或以上的货物。（去年登陆火星的毅力号火星车连同着陆器总重约4吨。）

低成本发射可能不会立即带来革命性改变。航天科考任务费用高昂，即使是高成本的发射也只占到总预算的一小部分。但赫尔德曼指出，星舰能让科学家展开野心大得多的任务，花同样的钱做更多的事。她说，一种选择是携带更多更便宜的设备上太空。“这么大的有效载荷能力意味着可以使用现成的部件，而不必做专门定制和小型化。”她说。

另一种选择就是直接带一个大设备。毅力号耗资27亿美元，携带了一个可以在火星风化层中下钻几英寸的钻头。赫尔德曼说，星舰可以携带一个全尺寸的钻机，能钻几公里深。

它还可以打开通往外行星的通道，这些外行星历来都很难探索。近年来，土星和木星有水的卫星已经超越火星，成为最有希望找到外星生命的地方。一组科学家已经制定了利用星舰探索海王星的计划，此前人类只在1989年造访过海王星一次，当时美国旅行者2号（Voyager 2）探测器在离开太阳系的途中高速飞越过海王星。星舰这样的航天器可能重达数十吨，而旅行者2号只有722公斤。

美国政府是另一个潜在客户。它新成立的太空部队（Space Force）正在研究将星舰用于其火箭货运（Rocket Cargo）计划，该计划旨在探索能否利用这样的火箭快速将装备运往地球上的任何地方。而鉴于太空在交战中的重要性，美国的武装部队将很乐于拥有快速、廉价地补充被击落的卫星的能力。

与此同时，在雄心勃勃的阿尔忒弥斯（Artemis）计划中，NASA选择了用星舰上面级的改装版将宇航员运送到月球表面。阿尔忒弥斯计划使用的主要运载工具是太空发射系统（SLS），这是NASA正在开发的另一种用来替

代航天飞机的巨型火箭。但SLS的货运荷载比星舰小，发射成本预计为一次20亿美元。如果星舰行得通，NASA可能会面临完全放弃SLS的压力。

SpaceX自己可是非常清楚它想用星舰做什么，哪怕是在它开始考虑殖民火星之前。它的星链（Starlink）项目想利用成千上万在低轨道成群飞行的卫星将高速互联网信号发送到地球表面的任何地方。SpaceX的首席执行官格温·肖特维尔（Gwynne Shotwell）曾指出全球电信市场可能价值每年一万亿美元。SpaceX认为，如果自己想要分得其中的3%到4%，可能并不为过。

因为低轨道飞行的卫星只能覆盖地球表面的一小部分，所以星链需要大量卫星。SpaceX已经有大约1655颗卫星，约占太空活跃卫星总数的三分之一。它已获得美国监管机构发射1.2万颗卫星的许可，并正在努力获得再发射三万颗的许可。

但首先SpaceX得让星舰正常运作。在新闻发布会上，马斯克竭力淡化轨道测试顺利进行的可能性——也不知道何时能进行。即便测试顺利完成，在星舰准备好运送真正的货物之前，也还需要更多的测试。

SpaceX也可能面临监管争端。在博卡奇卡基地建立时，双方的共识是它将用于试射猎鹰重型火箭，这种火箭比星舰要小得多。曼利说，试验失败导致的爆炸让碎片散落在大片区域，道路封闭又惹恼了当地人。据报道，环境监管部门对此不满，正在推动对SpaceX获得的发射许可展开全面审查。马斯克曾表示，在最糟糕的情况下，SpaceX将不得不将星舰的开发转移到佛罗里达州的卡纳维拉尔角（Cape Canaveral），这将令开发进程延误数月。

| 紧张的能量

即便如此，星舰最后可能也没有用武之地。星链的真实市场规模仍然未知。至于马斯克最大的抱负，目前也全不清楚有多少人会自愿搬去火星住。马斯克是这么推销移民火星的：“会局促、危险、困难、非常艰苦，你可能会送命。”

尽管面临重重技术挑战，要赌SpaceX无法成功也需要很大的胆量。2008年，在猎鹰1号小型火箭前三次发射失败后，这家公司差点倒闭。但第四次发射成功了。猎鹰9号连续成功发射，成就斐然，但在此之前它的第一级曾十多次着陆失败。马斯克本人很有信心。“[星舰]会成功的，”他说，“沿途会有些颠簸，但它终究会成功的。”





The undiscovered country

“This Mortal Coil” is a surprisingly upbeat history of death

Andrew Doig's study of how people die is a story of human ingenuity

This Mortal Coil. By Andrew Doig. Bloomsbury; 384 pages; £25

FOR OVER 200 years, France has diligently recorded the life spans of its citizens. Since 1816 their average life expectancy has more than doubled: long skewed by high infant mortality, it jumped from 41.1 years to 85.3 for French women, and from 39.1 years to 79.3 for men. In other words, it “has increased on average by five hours per day”, writes Andrew Doig in “This Mortal Coil”, a study of how people die. “So, every day, the date of a French person’s death gets closer by 24 hours due to the passing of time, but recedes by five hours, thanks to medicine, nutrition, sanitation, good government, trade, peace and so on.”

You might expect a book on this morbid theme to be forbidding or sombre. This one is neither. Instead Mr Doig, a biochemist at the University of Manchester, tells an empowering story of human ingenuity.

For most of human history, life expectancy hovered around 30. The oldest anatomically modern humans, who lived around 200,000 years ago, often died in accidents—in falls, say, or by drowning—or were killed by large animals during hunts or by other people. About 10,000 years ago humans discovered agriculture, and previously nomadic populations settled to grow fields of wheat, barley and maize. Farmers could suddenly produce a lot more food than people had before; but, counter-intuitively, that did not translate into an explosion in the species. The world’s human population increased only from 4m in 10,000BC to 5m in 5000BC.

Farming, it turned out, had some big downsides. Not only did it involve

back-breaking labour; it brought new diseases to people. Most of the infections that plague humans today come from bugs that once lived in animals and crossed the species barrier. Measles derives from the rinderpest virus in cattle and influenza from poultry. Living in close quarters with animals meant a higher chance of catching their lurgies. Dense settlements and cities let new ailments spread quickly. Their appearance repeatedly obliterated human communities; it took generations for natural resistance to evolve and spread.

The fight against infectious diseases made a step-change around 250 years ago in Europe and North America. Mr Doig devotes chapters to some of the major infections of the medieval era, including bubonic plague, smallpox, typhoid and cholera. His gut-wrenching descriptions of disease and death—stinking, weeping boils, diarrhoea and worse—serve as background to the larger story of how people began to apply reason to their understanding of illnesses. In the process, they invented the seeds of modern medicine.

In 1747 James Lind, a Scottish doctor, designed a systematic experiment to show that citrus fruits could cure scurvy. Fifty years later, Edward Jenner, an Englishman, discovered that people could be protected from smallpox if they were inoculated with pus from the blisters of milkmaids who had contracted a related disease, cowpox. In 1854 John Snow, a doctor in London, was studying cholera, the “most terrifying disease of the 19th century”, which could plunge a person from good health to death in only 12 hours. He gathered data on where cholera-affected households in Soho had been getting their water. Around the same time in Vienna, Ignaz Semmelweis, a Hungarian, showed that cleanliness in maternity hospitals could save the lives of new mothers.

Such were the respective origins of clinical trials, vaccination, epidemiology and good hygiene. At last, humans were acquiring decisive

weapons against infections and, from the mid-19th century, life expectancy began to rise. Death, however, remained inevitable. As some versions of it fade, others take their place.

The early 21st century might be the healthiest time ever to be alive; modern medicine has given people in developed countries tremendous lifespans. But all bodies fail eventually. The top causes of death today are coronary heart disease, stroke and lung diseases including asthma, emphysema and pneumonia. Cancers are now known to comprise several types of disease, but, if grouped together, they kill almost as many people as heart troubles. Human behaviour has exacerbated some of these afflictions: processed junk food, smoking, alcohol and lack of exercise all damage human bodies.

| *The whips and scorns of time*

A looming spectre is dementia. The numbers of elderly people are rising so fast that the incidence of debilitating, costly conditions such as Alzheimer's and Parkinson's is growing rapidly. Here science is still stumped: in contrast to the arsenals available to fend off other causes of death, there are no drugs to slow or halt these terrifying brain diseases. Mr Doig's conclusion is grim but realistic: "We seem to be heading for a world of elderly people with functioning bodies, but demented minds."

Nevertheless, he is an optimist. He points to medical marvels that may lie ahead—such as 3D-printed organs that could make it routine to go into hospital at 60 to "freshen up" with new lungs, kidneys, liver or pancreas, grown from stem cells and optimised by genetic editing. "We could then have hearts like Usain Bolt and lungs like Serena Williams," he writes. "Many more of us would only die when our brains can no longer function." The "years of living with chronic disability", which now blight old age, would be over.

These are remarkable prospects. But, as Mr Doig knows, ultimately they are

distractions from the immutable fact that, however ingenious medicine becomes, one day, it will all end. ■



未知国度

《死亡牵绊》以意外的乐观讲述人类死亡史

安德鲁·多伊格对人类死因的探究也是关于人类智慧的故事【《死亡牵绊》书评】

《死亡牵绊》，安德鲁·多伊格著。布鲁姆斯伯里出版公司；384页；25英镑。

两百多年来，法国一直在认真记录其公民的寿命。自1816年以来他们的平均预期寿命增长了一倍多：在长期被高婴幼儿夭折率拉低后，法国女性的平均预期寿命从41.1岁跃升至85.3岁，男性从39.1岁跃升至79.3岁。换句话说，法国人的预期寿命“平均每天延长五小时”，安德鲁·多伊格（Andrew Doig）在研究人类如何死亡的书作《死亡牵绊》（This Mortal Coil）中写道。“也就是说，每过一天，每个法国人离死期又近了24个小时，但得益于医药、营养、卫生、善政、贸易、和平等因素，死期又推后了五小时。”

你或许会以为一本讲述死亡这种暗黑题材的书读来会可怕或阴郁。这本书可不是这样。相反，身为曼彻斯特大学生物化学家的多伊格讲述了一个关于人类智慧的鼓舞人心的故事。

在人类历史的大部分时间里，预期寿命徘徊在30岁左右。从解剖学意义上说最古老的现代人生活在约20万年前，他们常常死于坠或溺水等意外，或者是死于狩猎时大型动物的袭击，还有他杀。大约一万年，人类开始发展农业，从前的游牧人口定居下来种植小麦、大麦和玉米。突然间，农民可以生产出的食物相比前人大幅增长。但有违直觉的是，这并没转化为人口的爆炸性增长。从公元前一万年到公元前5000年，全球人口仅从400万增加到了500万。

事实证明，农耕存在一些很大的弊病：不仅需要人们从事繁重的体力活，还给他们带来了新的疾病。今天困扰人类的大多数传染病来自一度寄居在动物身上并跨越了物种屏障的寄生虫。麻疹来自牛身上的牛瘟病毒，流感

来自家禽。与动物近距离生活意味着有更大几率感染它们身上携带的疾病。密集定居和城市导致新疾病迅速蔓延。疾病的出现一再毁灭人类群落，要经过几代人的时间才能演进出普遍的自然抵抗力。

大约250年前，欧洲和北美对传染病的防治实现了飞跃。多伊格用好几个章节介绍了中世纪一些主要的传染病，包括鼠疫、天花、伤寒和霍乱。他对疾病和死亡做了让人反胃的描写（发臭流脓的疖疮、腹泻及更糟糕的情形），以此为背景讲述人们如何开始运用理性来理解疾病的更宏大的故事。在这个过程中，人们发明并播下了现代医学的种子。

1747年，苏格兰医生詹姆斯·林德（James Lind）设计了一个系统性实验，证明柑橘类水果可以治愈坏血病。50年后，英国人爱德华·詹纳（Edward Jenner）发现，如果接种挤奶女工感染的牛痘（天花病毒的近亲）水泡中的脓液，可以让人免于感染天花。1854年，伦敦医生约翰·斯诺（John Snow）研究霍乱，这是“19世纪最可怕的疾病”，可以让一个健康人在短短12小时内急性发病而死。他收集了苏荷区感染霍乱的家庭从何处取水的数据。大概同一时间，匈牙利人伊格纳茨·塞梅尔韦斯（Ignaz Semmelweis）在维也纳指出，产科医院保持干净卫生有助提升产妇存活率。

上述研究分别是临床试验、疫苗接种、流行病学和讲究卫生的起源。最后，人类终于获得了对抗感染的决定性武器，从19世纪中期开始人类的预期寿命开始上升。不过死亡仍然无可避免。一些致死的原因消失了，另一些取而代之。

21世纪初可能是人类史上最健康的时代，现代医学让发达国家的人们得享长寿。但人体终有一天会衰竭。如今人们的主要死因是冠心病、中风和肺部疾病，包括哮喘、肺气肿和肺炎。现在人们已了解到癌症其实包含了多种疾病，但如果都算在一起，癌症的致死人数几乎与心脏病一样多。人类的行为助长了其中一些疾病：食用加工垃圾食品、吸烟、饮酒和缺乏运动都会损害人体。

| 岁月的蹂躏

一个日益逼近的阴影是痴呆症。老年人口迅速扩大，使得阿尔茨海默症和帕金森氏症这类治疗费用高昂的退行性疾病的发病率也在急升。在这方面，科学仍茫然无措：我们有丰富的武器库抵御其他致死疾病，相比之下，却没有任何药物可减缓或阻止这些可怕的脑部疾病。多伊格的结论严峻而现实：“这样下去，我们的世界似乎将充斥身体尚可但头脑痴呆的老年人。”

不过多伊格是个乐观主义者。他认为未来可能出现医学奇迹，例如3D打印器官，让人们在60岁时可以如家常便饭般去医院换上全新的肺、肾、肝或胰腺——它们由干细胞培育并通过基因编辑优化——让身体“焕然一新”。“我们可以拥有博尔特那样的心脏和小威廉姆斯那样的肺，”他写道，“我们更多人只会在大脑不能再运作时才会死亡。”如今困扰老年人的那些“长期失能的残年日子”将会终结。

这样的前景很了不起。但多伊格知道，最终，这不过是一些题外话，主题仍是那不可改变的事实，即无论医学发展得多精妙，人终有一死。■



Free exchange

How to avoid a fatal backlash against globalisation

Studying how the first era ended could help preserve the second

IN 1920 JOHN MAYNARD KEYNES reflected on the Britain he knew before the outbreak of the first world war. “The inhabitant of London”, he wrote, “could order by telephone, sipping his morning tea in bed, the various products of the whole earth.” Keynes’s Londoner “regarded this state of affairs as normal, certain and permanent”, and not long ago the globalisation of the present age seemed a similarly inexorable force. A new world war remains unlikely, but the uncomfortable echoes of the past in recent history suggest that a closer look at the rise and retreat of 19th-century globalisation might yield valuable lessons.

A work of economic history published in 1999 provides a great starting point. “Globalisation and History”, by Kevin O’Rourke and Jeffrey Williamson, hit shelves at a time of growing unease about the effects of deepening economic integration. Then, anti-trade activists swarmed meetings of the World Trade Organisation, while a few economists began to draw attention to the occasionally troubling distributional effects of globalisation. It roared on nonetheless over the first decade after the book’s publication. But in the years since, economic nationalism has become a potent political force, and the book has come to seem eerily prescient.

Nineteenth-century integration began in earnest around mid-century, after decades of instability and insularity. Liberalised trade rules helped; Britain repealed its Corn Laws—tariffs on imported grain—in 1846. But the integration of markets was supercharged by improvements in communication and transport technologies which allowed for faster, cheaper and more reliable movement of people, goods and information. The telegraph, steamships and railways brought the economies of Europe

and the Americas into close contact, with profound consequences. In the new world, land was abundant and cheap, and wages were high. The reverse was true in Europe, where workers were plentiful and landowners collected fat rents. As these markets integrated, prices converged. In 1870 British wheat prices were 60% above those in America; by 1890 the gap had mostly closed. When telegraph cables connected distant financial markets, differences in the pricing of various securities vanished almost immediately.

Simple trade theory predicts that as differences in the prices of traded goods shrink, the cost of factors of production like land and labour should likewise converge. Experience in the 19th century bore this out. As waves of American grain spilled into European ports, land prices in Europe tumbled toward those across the pond. In America, the real price of land tripled between 1870 and 1913, while in Britain, it dropped by nearly 60%. Real wages converged as well, although the authors note this owed more to migration than trade. Nineteenth-century migrant flows were unlike anything in recent memory. Between 1870 and 1910 they reduced Sweden's labour force by 20% relative to what it otherwise would have been, and increased America's by 24%. These flows transformed labour markets. Real wages earned by unskilled labourers in Ireland rose from roughly 60% of the British level in the 1840s to 90% in 1914, thanks entirely to Irish emigration.

How much can really be learned from such a different world? Today, migration matters much less than it did in the 19th century. Skilled workers account for a far larger share of rich-world workforces, and are protected by modern regulations and social safety-nets. Trade consists not only of bulk commodity shipments, but of components imported and exported multiple times along complex supply chains. Forget telegraphs; in meetings today people chat face-to-face with colleagues on other continents.

Yet a number of lessons appear relevant. Start with the issue of convergence in incomes across countries. Much of modern theorising about convergence focuses on the role of capital accumulation and technological progress. Poor countries grow rich, in these models, because they invest more and adopt more sophisticated technologies. But in the 19th century the integration of markets drove convergence: a force which has also been at work in recent decades. The narrowing gap between American and Chinese wages is in part a story of Chinese technological progress. Yet it is also one in which hundreds of millions of Chinese workers began participating in a global economy, making low-skilled labour more abundant globally and contributing to weaker blue-collar wage growth and higher inequality in rich countries.

Second, people in the 19th century generally understood the effects that trade and migration had on their economies, and those on the losing end sought political solutions to their troubles. Then, as now, training and education were touted as answers to the problems of unhappy workers. But moves to improve schooling were accompanied by a broad shift towards protectionism. From the 1870s European economies, with the notable exception of Britain, began raising tariff rates. Over the same period, migration policy in the Americas became ever more restrictive.

| *Don't spoil the ending*

So it has gone this time, too. Work by David Autor of the Massachusetts Institute of Technology and three co-authors found that American counties which were more exposed to imports from China became more likely to vote Republican in presidential elections, for example: a shift which in 2016 helped to elect a trade-warring president.

And yet third and most important, it was not higher tariff barriers or restrictions on migration which plunged the world into the deep and destructive insularity that took hold after 1914; it was war. But for war, the

retreat of globalisation a century ago may have remained modest and short-lived. The same may be true today. If inattention to the distributional effects of trade can prompt a backlash, then a greater commitment to sharing the bounty generated by openness might permit a renewal of economic integration—if the world remains willing to learn from the past.





自由交流

如何避免对全球化的灾难性抵制

研究第一波全球化如何结束有助于守护好第二波

一九二〇年，凯恩斯回顾了他所了解的一战爆发前的英国。“伦敦人，”他写道，“可以一边在床上喝着早茶，一边打电话订购全世界的各种产品。”凯恩斯笔下的伦敦人“以为这种状态很寻常、很确定，会一直持续下去”。而就在不久前，我们这个时代的全球化同样显得势不可挡。目前来看，一场新的世界大战仍然不大可能爆发，但近代历史上一些情景令人不安地重现，提醒人们仔细审视19世纪全球化的兴衰可能会得到宝贵的经验教训。

1999年出版的经济史著作《全球化与历史》（Globalisation and History）提供了一个很好的切入点。这本书的作者是凯文·奥洛克（Kevin O'Rourke）和杰弗里·威廉姆森（Jeffrey Williamson）。它上架之时，正值人们对经济一体化日益深化带来的影响越发不安。当时，反贸易活动人士围堵在世贸组织的会议现场，而个别经济学家也开始呼吁关注全球化那偶尔令人困扰的分配效应。尽管如此，在这本书出版后的头十年里，全球化的车轮继续滚滚向前。但在那之后，经济民族主义已成为一股强大的政治力量，而这本书也开始显得出奇地有预见性。

大约19世纪中叶，在经历了几十年的动荡和孤立封闭之后，全球经济一体化正式拉开序幕。自由化的贸易规则发挥了作用：1846年英国废除了对进口谷物征收关税的《谷物法》。但市场一体化的强力推手还是通讯和交通运输技术的进步，它们让人员、商品和信息的流动变得更快、更便宜，也更可靠。电报、蒸汽轮船和铁路把欧洲和美洲的经济体紧密联系在一起，产生了深远的影响。在新大陆，土地又多又便宜，工资也很高。而欧洲的情况正好相反——有大量的工人，土地所有者收取高昂的租金。随着这些市场融合，价格也趋于一致。1870年，英国的小麦价格比美国高出60%，而到了1890年，这一差距几乎已经抹平。在电报电缆把相隔遥远的各个金融市场连接起来之后，各种证券的定价差异几乎顷刻间就消失了。

根据简单的贸易理论，随着贸易商品的价格差异缩小，土地和劳动力等生产要素的成本也会趋同。19世纪的经验证实了这一点。随着一批又一批美国产谷物涌入欧洲的港口，欧洲的土地价格朝着大西洋彼岸的水平暴跌。在1870年到1913年间，美国土地的实际价格上涨了两倍，而英国土地价格却下跌了近60%。实际工资也趋于一致，不过《全球化与历史》的作者指出这更多是因为移民而非贸易所致。19世纪的移民潮与今天的人们记忆所及的任何一次都不一样。1870年到1910年间，移民潮让瑞典的劳动力减少了20%（相比没有移民的情况），而让美国的劳动力增加了24%。这些人员流动改变了劳动力市场。爱尔兰非技术型工人的实际工资从1840年代约相当于英国水平的60%上升到1914年的90%，而这完全是爱尔兰人移居国外造成的。

究竟能从一个如此不同的世界学到多少东西？今天，移民的影响远不及19世纪。技术工人占富裕国家劳动力的比例要大得多，而且受到现代法规和社会保障体系的保护。贸易不仅包括大宗商品的运输，还包括通过复杂的供应链多次进出口的零部件。别提什么电报了，如今人们在开会时可以和身处其他大洲的同事面对面地交谈。

但还是能找到一些有益的经验。先从各国收入趋同的问题说起。现代有关趋同的理论研究大多聚焦于资本积累和技术进步的作用。根据这些理论模式，穷国因为加大投资和采用更先进的技术而变得富裕。而在19世纪，收入趋同是由市场一体化推动的——最近几十年这股力量也在发挥作用。美国和中国工资差距的缩小一定程度上是中国技术进步的结果。不过还有一个原因是数以亿计的中国工人开始参与全球经济，让全球低技能的劳动力更加充足，从而导致富裕国家的蓝领工资增长疲软以及不平等加剧。

其次，19世纪人们普遍认识到了贸易和移民对本国经济的影响，受损失的一方便寻求政治手段来解决困境。和现在一样，在当时培训和教育也被标榜能解决不幸工人的问题。但是，在采取措施改善学校教育的同时，世界各国也开始普遍转向保护主义。从19世纪70年代起，欧洲各经济体都开始提高关税，唯英国是个特例。在同一时期，美洲的移民政策变得越来越严格。

| 别毁了结局

本次全球化的进程也是如此。例如，麻省理工学院的戴维·奥托尔（David Autor）和三位合著者的研究发现，美国那些受中国进口商品冲击更多的县在总统选举中更有可能投给共和党——这种趋势在2016年就帮助选出了一位打贸易战的总统。

第三点也是最重要的一点：让世界在1914年之后深陷毁灭性的孤立封闭的并非更高的关税壁垒或对移民的限制，而是战争。如果不是战争，一个世纪前的这次全球化倒车可能只是温和而短暂的。今天的情况可能也一样。如果忽视贸易的分配效应会引发人们抵制全球化，那么，加大力度来分享开放所带来的红利就可能带来经济一体化的复兴——只要世界仍然愿意以史为鉴。■



Trading with the enemy

The economic consequences of the war in Ukraine

Expect higher inflation, lower growth and some disruption to financial markets

OVER THE past decade intensifying geopolitical risk has been a constant feature of world politics, yet the world economy and financial markets have shrugged it off. From the contest between China and America to the rise of populist rulers in Latin America and tensions in the Middle East, firms and investors have carried on regardless, judging that the economic consequences will be contained.

Russia's invasion of Ukraine is likely to break this pattern, because it will result in the isolation of the world's 11th-largest economy and one of its largest commodity producers. The immediate global implications will be higher inflation, lower growth and some disruption to financial markets as deeper sanctions take hold. The longer-term fallout will be a further debilitation of the system of globalised supply chains and integrated financial markets that has dominated the world economy since the Soviet Union collapsed in 1991.

Start with the commodity shock. As well as being the dominant supplier of gas to Europe, Russia is one of the world's largest oil producers and a key supplier of industrial metals such as nickel, aluminium and palladium. Both Russia and Ukraine are major wheat exporters, while Russia and Belarus (a Russian proxy) are big in potash, an input into fertilisers. The prices of these commodities have been rising this year and are now likely to rise further. Amid reports of explosions across Ukraine, the price of Brent oil breached \$100 per barrel on the morning of February 24th and European gas prices rose by 30%.

The supply of commodities could be damaged in one of two ways. Their

delivery might be disrupted if physical infrastructure such as pipelines or Black Sea ports are destroyed. Alternatively, deeper sanctions on Russia's commodity complex could prevent Western customers from buying from it. Up until now both sides have been wary about weaponising the trade in energy and commodities, which continued throughout the cold war. Sanctions after the invasion of Crimea did not prevent BP, ExxonMobil or Shell from investing in Russia, while American penalties on Rusal, a Russian metals firm, in 2018 were short-lived. Germany's decision to mothball the Nord Stream 2 gas pipeline on February 22nd was largely symbolic since it does not yet carry gas from Russia to the West.

Nonetheless the prospect now is of more Western restrictions on Russia's natural-resources industry that curtail global supply. Russia may retaliate by deliberately creating bottlenecks that raise prices. America may lean on Saudi Arabia to increase oil production and prod its domestic shale firms to ramp up output.

The second shock relates to tech and the global financial system. While the trade in natural resources is an area of mutual dependency between the West and Russia, in finance and tech the balance of economic power is more one-sided. America is thus likely to put much tougher Huawei-style sanctions on Russian tech firms, limiting their access to cutting-edge semiconductors and software, and also blacklist Russia's largest two banks, Sberbank and VTB, or seek to cut Russia off from the SWIFT messaging system that is used for cross-border bank transfers.

The tech measures will act as a drag on Russia's growth over time and annoy its consumers. The banking restrictions will bite immediately, causing a funding crunch and impeding financial flows in and out of the country. Russia has sought to insulate its economy from precisely this: the share of its invoices denominated in dollars has slumped since its invasion of Crimea in 2014, and it has built up foreign-exchange reserves. Still, it will

hurt. Russia will turn to China for its financial needs. Already trade between the two countries has been insulated from Western sanctions, with only 33% of payments from China to Russia now taking place in dollars, down from 97% in 2014.

Western banks appear to have fairly low exposure to Russia. Nonetheless, since the modern era of globalisation began in the 1990s no major economy has been cut off from the global financial system, and the risk of broader contagion across markets, while apparently low, cannot be ruled out.

What does all this mean for the global economy? Russia faces a serious but not fatal economic shock as its financial system is isolated. For the global economy the prospect is of higher inflation as natural-resource prices rise, intensifying the dilemma that central banks face, and a possible muting of corporate investment as jittery markets dampen confidence.

The longer-term impact will be to accelerate the division of the world into economic blocs. Russia will be forced to tilt east, relying more on trade and financial links with China. In the West more politicians and firms will ask if a key tenet of globalisation—that you should trade with everyone, not just your geopolitical allies—is still valid, not just for Russia but other autocracies. China will look at Western sanctions on Russia and conclude that it needs to intensify its campaign of self-sufficiency. The invasion of Ukraine might not cause a global economic crisis today but it will change how the world economy operates for decades to come. ■



与敌通商

乌克兰战争的经济后果

推高通胀，拖慢增长，以及扰乱金融市场

过去十年里，不断加剧的地缘政治风险是世界政治一个不变的特征，但世界经济和金融市场对此不以为然。从中美角力到拉美民粹主义统治者的崛起，再到中东的紧张局势，企业和投资者并不过多理会，认为经济上的影响总会得到控制。

俄罗斯入侵乌克兰很可能打破这一局面，因为它将使世界第11大经济体和头号大宗商品生产国之一陷入孤立。最直接的全球影响将是通胀上升、增长放缓，以及随着制裁力度加大，金融市场也会受到一定程度的扰乱。从更长远来看，自1991年苏联解体以来主导世界经济的全球化供应链和一体化金融市场的体系将进一步被削弱。

先从大宗商品的冲击说起。俄罗斯不仅是欧洲最主要的天然气供应方，也是世界最大产油国之一，还是镍、铝、钯等工业金属的主要供应国。俄罗斯和乌克兰都是小麦出口大国，而俄罗斯和白俄罗斯（俄罗斯的代理国）是化肥原料碳酸钾的供应大户。这些大宗商品的价格今年持续上涨，现在应该还会涨得更高。随着乌克兰各地发生爆炸的消息传出，布伦特原油价格在2月24日上午突破每桶100美元，欧洲天然气价格也飙升了30%。

大宗商品供应可能以两种方式被破坏。如果管道或黑海港口等实体基础设施损毁，大宗商品运输可能就会中断。或者，对俄罗斯大宗商品产业的深度制裁有可能让西方客户无法再从俄罗斯采购。到目前为止，双方都谨慎避免把能源和大宗商品贸易用作对抗手段——在整个冷战年代这被持续使用。在俄罗斯入侵克里米亚后对它的制裁也没有阻止BP、埃克森美孚或壳牌在俄投资，美国在2018年对俄罗斯金属公司俄铝（Rusal）的惩罚也是草草了事。2月22日，德国决定搁置北溪2号天然气管道，此举基本上是象征性的，因为该管道尚未开始向西方输送俄罗斯的天然气。

尽管如此，未来西方还是很可能对俄罗斯的自然资源产业实施更多限制，导致全球供应缩减。作为报复手段，俄罗斯可能会故意制造瓶颈来抬高价格。美国可能会依赖沙特阿拉伯增加石油产量，同时督促本国企业增产页岩油气。

第二个冲击朝向科技和全球金融体系。西方与俄罗斯在自然资源贸易上相互依赖，但在金融和科技方面，经济实力更加一边倒。因此美国很可能会对俄罗斯的科技公司实施远比华为更强硬的制裁，限制它们获得尖端半导体和软件，同时还可能将俄罗斯最大的两家银行——俄罗斯联邦储蓄银行（Sberbank）和俄罗斯外贸银行（VTB）——拉入黑名单，或者试图将俄罗斯逐出跨境银行转账的SWIFT系统。

久而久之，科技制裁将拖累俄罗斯的经济增长，令其消费者不满。对银行业的限制会即刻产生影响，导致资金短缺，阻碍进出俄罗斯的金融流动。俄罗斯一直力求使其经济免受这种影响：自2014年入侵克里米亚以来，它大大降低了美元计价票据所占的比例，同时也累积起大量外汇储备。但金融限制仍会给它带来打击。俄罗斯将转向中国来满足其金融需求。两国之间的贸易现在已经基本对西方制裁免疫，中国对俄贸易付款只有33%采用美元，低于2014年的97%。

西方银行对俄罗斯的风险敞口似乎相当低。尽管如此，自1990年代现代全球化开始以来，还没有哪个大型经济体被完全隔绝在全球金融体系之外。在各地市场之间传播危机的风险虽然看起来较低，但并不能完全排除。

这一切对全球经济意味着什么？在自身金融体系被孤立之后，俄罗斯面临着严重的经济冲击，但并不致命。至于全球经济，随着自然资源价格上涨，未来通胀可能上升，加剧各国央行面临的窘境；与此同时，紧张不安的市场会打击信心，可能抑制企业投资。

从更长期来看，这将使世界加速分裂成为不同的经济阵营。俄罗斯将被迫倒向东方，更加依赖与中国的贸易和金融联系。在西方，会有更多政客和企业质疑全球化的一个关键信条——应该和所有人做贸易，而不仅仅是和

地缘政治盟友——是否仍然成立。这个问题不仅涉及俄罗斯，还涉及其他威权国家。看到西方对俄罗斯的制裁，中国会认定应该更加努力实现自给自足。俄罗斯入侵乌克兰或许不会立刻引发全球经济危机，但将会改变未来几十年里世界经济的运行方式。 ■



Schumpeter

How Gazprom helps the Kremlin put the squeeze on Europe

Vladimir Putin's python may tie itself in knots

THE BUSINESS pages of newspapers tend to deal with the cut and thrust of competition, rather than the cacophony of war. But when it comes to Vladimir Putin's assault on the sovereignty of Ukraine, there is a company—the world's largest gas producer—that is right in the thick of it. Gazprom, majority-owned by the Russian state, has mastered the art of furthering the Kremlin's interests as well as its own commercial ones. That extends to squeezing European gas supplies until the pips squeak. On February 22nd it received a dose of its own medicine when Germany said it would mothball the Nord Stream 2 (NS2) pipeline owned by Gazprom in retaliation for Russia's warmongering in Ukraine. Two days later Russia attacked Ukraine. Even those two events may not stop the firm from making mischief—and money.

To understand Gazprom, it helps to remember it is a child of the cold war, born from the Soviet Union's Ministry of the Gas Industry in 1989. Its boss, Alexey Miller, has run it since 2001, the year after Mr Putin took power. The two men are cut from the same cloth. When America imposed sanctions on Mr Miller in 2018, he remarked: "Finally I've been included. It means we are doing everything right." Investors in the West, who buy Gazprom stock for a spectacular dividend yield, lament that it splurges on projects that benefit the state, not shareholders; a plan to build the world's second-tallest skyscraper in St Petersburg is a case in point. As for mixing politics with commerce, its business model relies on a monopoly on the high-margin export of piped natural gas in order to cross-subsidise cheap gas to Russians. In a land of frozen winters, that is a precious quid pro quo for Mr Putin.

The run-up to war in Ukraine offered a textbook lesson in how Gazprom served the government's interests while feathering its own nest. For years its efforts to circumvent Ukraine, an important transit route for its gas, led it to construct alternative pipelines into northern and southern Europe that were intended to strengthen its bargaining power when its contract with Ukraine ended in 2024. These efforts also set European countries that stood to win and lose from the new configurations against each other. Gazprom's decision to dribble only a bit of surplus gas to Europe as demand there soared in recent months had a commercial logic—the resulting spike in spot prices translated into record profits. However, it also sent a message: Europe should not take Gazprom for granted. “It suits their purposes to keep Europeans on their toes,” says Jack Sharples of the Oxford Institute for Energy Studies, a think-tank.

Since the cold war, western European countries have tended to shrug off this nasty side of Gazprom. Instead they have become overdependent on its gas. Germany, which gets about half of the fuel from Russia, is in a particularly invidious position. Some Gazprom hangers-on, like Gerhard Schröder, an ex-chancellor who chairs Nord Stream, deserve special ignominy. Former Eastern bloc countries, such as Poland, have no such illusions. They know that as well as extending the hand of friendship, Gazprom can wield the knuckle duster. They are also the most exposed, observes Anna Mikulska, an expert on Russian energy at Rice University's Baker Institute. The most extreme case is Ukraine, where Gazprom provided cheap gas and other benefits, then turned them on and off as punishment for the country's westward drift. Recently Moldova has suffered similar treatment.

Russia's war against Ukraine paints Gazprom's geopolitical thuggery in stark relief. It sent prices of Brent crude soaring above \$100 a barrel, their highest level since 2014. It caused a surge in prices of natural gas, of which Russia is the world's second-biggest producer. The so-called Brotherhood

Network running through Ukraine used to be the main transit route for Gazprom's gas into Europe, though supplies have dwindled recently. Nonetheless, fears that vital pipelines will be destroyed are likely to keep gas prices elevated. So will concerns that Mr Putin could turn off the taps as part of his war effort, though he may prefer European cash pouring into his coffers. While Gazprom continues to supply Europe, high prices are good for it.

Germany's decision to halt the approval process for NS2, a €9.5bn (\$10.7bn) underwater pipeline running from Russia to Germany, does not change much. It had already been suspended for legal reasons in Germany. The bigger question is whether sanctions will be imposed on Gazprom. Before the attack, the betting was that given how dependent on Gazprom Europe remained, the firm would not suffer much. Russia's potential eviction from the SWIFT interbank payments system—which some Western politicians are calling for—would probably not entirely sever Gazprom's links with its European customers, who still need a way to pay for its energy. An idea suggested by Ms Mikulska, among others, to sideline Gazprom with a "Gaslift" of liquefied natural gas (LNG), a maritime version of the airlift that overcame Russia's blockade of Berlin in 1948-49, looks like a long shot.

| *Put that in your pipeline*

At a time of war, Gazprom's fealty to the Kremlin is unlikely to be shaken. Being a loyal servant has won it the support it needs from the regime as other presidential pets, such as Rosneft, an oil giant, try to wrestle away its monopoly on piped-gas exports.

The conflict will do grave damage to Gazprom's reputation nonetheless. It is a wake-up call to European countries that they should invest in more terminals to import LNG, and further build up their renewables capacity to reduce dependence on Russia. It will be studiously watched in China, where Gazprom has pivoted in recent years in order to diversify its gas

customers away from Europe. China is likely to be less bothered by Mr Putin's belligerence. But even the Communist Party in Beijing has good reason to care about Gazprom's trustworthiness as it watches the squeeze on Europe. The python may yet end up tying itself in knots. ■



熊彼特

俄气帮助克里姆林宫钳制欧洲

普京的巨蟒可能“作茧自缚”

各大报刊的商业版面更多都是关注市场上的激烈竞争，而不是战场上的隆隆炮声。但在普京侵犯乌克兰主权时，有一家公司却身处战场的中央地带，那就是全球最大的天然气生产商。由俄罗斯政府控股的俄罗斯天然气工业股份公司（Gazprom，以下简称“俄气”）已经很擅长在扩大自己商业利益的同时，也促进克里姆林宫的利益。这包括以天然气供应为筹码极力要挟欧洲。2月22日，德国以其人之道还治其人之身，表示将叫停俄气的北溪2号管道项目，以报复俄罗斯在乌克兰的好战行径。两天后，俄罗斯对乌克兰发起袭击。但是，就连这两个事件也可能无法阻挡俄气继续挑事——和赚钱。

要了解俄气，就应该记得它是冷战的产物。它在1989年脱胎自前苏联的天然气工业部。现任老板阿列克谢·米勒（Alexey Miller）自2001年也就是普京就任总统的第二年开始掌舵。两人行事风格如出一辙。2018年美国对米勒实施制裁，他表示：“我终于也被制裁了。这意味着我们做的一切都是对的。”为了丰厚股息而购入俄气股票的西方投资者不满它在有利于政府而非股东的项目上大肆挥霍，比如计划在圣彼得堡建造世界第二高的摩天大楼。至于政商联结方面，俄气的商业模式依赖于垄断高利润的管道天然气出口，再交叉补贴向本国廉价供应天然气。在俄罗斯这个有着酷寒冬天的国家，这样的利益交换尤其受普京重视。

乌俄爆发战事前，俄气的举动教科书般地演示了如何在服务政府利益的同时谋求私利。多年来，俄气一直想方设法绕过乌克兰（俄气出口天然气的重要过境地）建造通往北欧和南欧的替代管道，以求能在2024年与乌克兰的合同结束时提升议价能力。这些努力也使得将在新管道版图中得失不一的欧洲国家鹬蚌相争。近几个月欧洲的天然气需求激增，而俄气决定只少量增加供气，这自有其商业盘算——由此造成的现货价格飙升转化为了创纪录的高利润。然而，这也传递了一个信号：别以为俄气会理所当然给欧

洲供气。“其目的是让欧洲人一直紧张不安。”智库牛津大学能源研究所（Oxford Institute for Energy Studies）的杰克·沙普勒斯（Jack Sharples）说。

冷战结束以来，西欧国家大多不把俄气这作恶的一面当回事，相反，它们已经变得过度依赖它供气。德国有约一半天然气从俄罗斯购入，尤其容易落得里外不是人。一些追捧俄气的人理应遭千夫所指，比如担任北溪项目董事会主席的德国前总理施罗德。波兰等前东欧集团国家则没有这样的幻想。它们知道俄气既可以伸出友谊之手，也可能挥舞钢铁拳套。而这些国家也最易受影响，美国莱斯大学贝克研究所（Baker Institute）的俄罗斯能源专家安娜·米库尔斯卡（Anna Mikulska）认为。最极端的例子是乌克兰。俄气向乌克兰提供廉价天然气及其他好处，然后不时切断输气以惩罚该国转向西方。最近，摩尔多瓦也遭受了类似的待遇。

此次俄罗斯对乌宣战让俄气的地缘政治恶行昭然若揭。战事令布伦特原油价格飙升至每桶超过100美元，达到2014年以来的最高水平。天然气价格也应声高涨，毕竟俄罗斯是世界第二大天然气生产国。穿过乌克兰的所谓“兄弟”管道网络曾经是俄气往欧洲输送天然气的主要管线，但近年供气量已逐渐减少。尽管如此，人们还是担心重要管道会被战事摧毁，天然气价格很可能因而持续走高。另外，市场还担心普京把断供天然气作为一种战争手段，这种担心同样会推高价格，虽然普京可能更喜欢欧洲人的钱涌入他的金库。在俄气继续向欧洲供气期间，高气价对它就是好事。

从俄罗斯到德国的海底输气管道北溪2号投资95亿欧元（107亿美元），德国叫停对它的审批程序并没有给事情带来多大变化，因为该工程本就已经因为法律问题而在德国暂停。更大的疑问是俄气会否受到制裁。在俄罗斯袭击乌克兰之前，市场估计，凭欧洲对俄气的依赖程度，这家公司不会受到太大的影响。即使俄罗斯被逐出SWIFT银行间支付系统（一些西方政客正呼吁这样做），俄气与欧洲客户的联系也可能不会被完全切断，毕竟欧洲总还是要有一个支付渠道来购买俄气的能源。米库尔斯卡等人提出了一个想法，通过海运液化天然气（类似1948年至1949年西方通过空运打破了苏联对柏林的封锁）来摆脱对俄气的依赖，但这似乎不太行得通。

| 引气入室

在战争时期，俄气对克里姆林宫的忠心是不可能被动摇的。扮演忠诚仆役让俄气从普京政府拿到了所需的支持，毕竟石油巨头俄罗斯石油公司（Rosneft）等其他受总统宠爱的企业也虎视眈眈地想要抢走俄气对管道天然气出口的垄断。

尽管如此，这场战事将严重损害俄气的声誉。它给欧洲国家敲响了警钟，提醒它们应该投资兴建更多进口液化天然气接收站，并进一步提升可再生能源的产能以减少对俄罗斯的依赖。中国将密切观察事态走向，近年来，俄气为了将客户多元化而不仅限于欧洲，已在转向中国市场。中国应该不太会担心普京的好战。但目睹欧洲当前所受的挤压，连北京当局也有充分理由担心俄气是否可信。也许俄气这条巨蟒最终会“作结自缚”。■



Industrial technology

Why Japan's Automation Inc is indispensable to global industry

A little-known pinch-point in the world's supply chains

SHORTAGES AND bottlenecks have been a source of constant frustration for manufacturers around the world for two pandemic-afflicted years. For a handful of companies in the business of keeping factories running and supply chains intact, these frustrations have been a source of cheer—and profits. Japanese makers of industrial equipment, in particular, have seen orders surge as companies turned to automation, first amid the disruption wrought on human workforces by covid-19, then as a result of tight labour markets and rising wage costs.

The world's stock of industrial robots has tripled in the past decade. According to the International Federation of Robotics, a trade group, Japan furnishes 45% of new ones each year. It also produces lots of other automation equipment, from laser sensors to inspection kit. Even after the recent sell-off in tech stocks, Japan's four standout gear producers—Keyence, Fanuc, SMC, and Lasertec—are collectively worth two and a half times what they were five years ago (see chart). Last year the founder of Keyence, Takizaki Takemitsu, briefly became Japan's richest man. His \$29bn fortune is half as large again as that of Son Masayoshi, a flamboyant tech investor who is corporate Japan's most globally recognisable face. Mr Takizaki's firm and its fellow equipment-makers are hardly household names. But the hardware they produce is becoming as mission-critical to many industrial supply chains as semiconductors are.

It is no surprise that Japan, a famously robot-loving place, has spawned a strong Automation Inc. Just-in-time manufacturing, pioneered by efficiency-obsessed Japanese companies such as Toyota in carmaking or Panasonic in consumer electronics, has involved replacing humans with

machines for decades. This source of competitive advantage became an existential necessity for domestic manufacturers after Japan's working-age population began to shrink in the 1990s. Today it is becoming one for other rich countries as they enter demographic dotage. Keyence and SMC now derive more than half their revenues from abroad. Fanuc and Lasertec are even more international, with more than 80% of sales coming from overseas.

Some of the new foreign demand is the result of the world's insatiable hunger for computer chips. SMC, which sells pneumatic control devices to chipmakers, has seen its business boom, especially as places including America and Europe strive to bring more semiconductor production home, says Masahiro Ota, who sits on SMC's board. Lasertec enjoys a near-monopoly on inspection tools for the most advanced semiconductor photomasks—plates through which circuit patterns are etched onto silicon wafers. Its share price has ballooned four-fold since the start of 2020, making it one of the best-performing blue-chip stocks in Asia. Keyence's precision sensors are likewise crucial for the detection of flaws in semiconductor surfaces.

The companies' devices are, of course, also handy in other sectors. Fanuc, which makes large factory-floor robotic arms, has long been a fixture of car assembly lines. Mike Cicco, who runs Fanuc's American operations, notes that the development of electric cars requires a range of new capabilities on the part of carmakers—and that in turn necessitates new types of robot. Fanuc expects to supply Ford's factory in Cologne, in Germany, with 500 robots this year as the plant becomes the Ford Cologne Electrification Centre.

Being indispensable has proved to be lucrative. All four stars of Japan's automation-industrial complex boast operating-profit margins of over 20%. That of Keyence, the most profitable of the lot, exceeds 50%. The firm

has reported record net profits in each of the past three quarters. Like chip firms such as Nvidia, Keyence does not manufacture products but rather designs them and assists customers in deploying them in their factories. Lasertec, too, does little of its own manufacturing. This capital-light approach helps sustain profits. Keyence spends just 3% of its net sales on research and development (R&D). Similarly, SMC spends around 4%. Fanuc does make almost all its products independently and invests more in production capacity and R&D. But it uses that capital efficiently, not least, as befits a robot-maker, by deploying plenty of its own robots to build robots for customers. Its biggest “lights out” factory can run for more than a month with no pricey human operators around.

Japan’s automation firms also owe some of their success to corporate culture. SMC maintains a network of 6,000 salespeople who double as systems engineers with in-depth knowledge of customers’ equipment. Keyence uses no middlemen to sell its products, relying entirely on its own sales force. As with SMC, many are engineers, who spend a lot of time on customers’ factory floors identifying niggles and tweaks that might otherwise go unnoticed. They are rewarded handsomely for their efforts. Nikkei, a Japanese publisher, reports that average salaries at Keyence exceeded \$150,000 in the last fiscal year.

The automation stars, like Japan Inc as a whole, tend to be less generous with shareholders. Most sit on piles of cash; Keyence held over \$10bn in current assets in the last financial year. The reserved character of the companies and their tightfistedness is so well-established that some investors say any sudden shifts in that attitude may be a sign of big and possibly unwelcome changes at the firms.

Investors have to rely on such rune-reading because it is not always clear what is going on inside the companies, at least by contemporary Western standards of open shareholder relations. SMC’s “traditional Japanese

approach to corporate governance”, as Baillie Gifford, a tech-focused British asset manager, delicately put it in 2020, offers only limited engagement with shareholders. One asset manager with a stake in Keyence reports never speaking directly with its management.

As the companies become ever more international, they will face pressure to be more candid—and less frugal, both with payouts to shareholders and with investments. Fanuc increased its dividend sharply in 2015 under pressure from Third Point, an American activist hedge fund. As Japan becomes less averse to gadfly investors, Automation Inc should expect more such calls. To maintain their innovative edge, meanwhile, the firms may need to spend considerably more on R&D. Amid tech-inflected geopolitical tensions with the West, China wants to reduce its reliance on foreign suppliers of all manner of advanced technology, including robotics. If successful, the Chinese strategy would at once deprive the Japanese firms of a big market and create new global rivals. Becoming indispensable is one thing. Staying so is quite another. ■



工业技术

为什么日本的自动化公司对全球工业不可或缺

全球供应链中一个鲜为人知的夹点

在新冠疫情肆虐的两年里，世界各地的制造商饱受各种短缺和瓶颈的困扰。而对于一小批以支持工厂运转和供应链完好为营生的公司来说，这些困扰却给它们带来了加油声——还有高利润。尤其是日本的工业设备制造商订单激增，因为此时很多企业转向自动化——起先是迫于新冠肺炎干扰人员工作，之后又因为劳动力市场吃紧和工资成本上升。

在过去十年里，全世界工业机器人保有量增加了两倍。据行业组织国际机器人联合会（International Federation of Robotics）称，每年全球新增的机器人中有45%产自日本。日本还生产从激光传感器到成套检测器材的许多其他自动化设备。即使是在最近的科技股抛售潮后，日本最著名的四家设备制造商——基恩士、发那科、SMC和Lasertec——的总市值仍是五年前的2.5倍（见图表）。去年，基恩士的创始人滝崎武光还一度晋身日本首富。目前他的财富达到290亿美元，比孙正义多一半——这位高调的科技投资人是日本商界在全球最知名的人物。虽说滝崎武光的公司和日本其他同类设备制造商远非家喻户晓，但对于许多工业供应链来说，它们生产的硬件正变得像半导体一样至关重要。

在一个出了名钟情于机器人的国度，培育出一个强大的自动化产业不足为奇。汽车制造商丰田和家用电器制造商松下等极度注重效率的日本公司率先推出了准时制生产方式（JIT），几十年来这种模式一直在用机器替代人类。上世纪90年代日本的劳动年龄人口开始萎缩后，这种带来了竞争优势的生产方式更是成为了本国制造商的生存必需。如今，随着其他富裕国家的人口老龄化，它们的企业生存也开始有赖于这种模式。基恩士和SMC现在超过一半的收入来自海外。发那科和Lasertec的国际化程度更高，有80%以上的销售额来自海外。

新增的国外需求一定程度上是由于世界对计算机芯片永无止境的渴求。

SMC向芯片制造商销售气动元件，公司董事太田昌宏表示，近期业务很红火，尤其是在欧美这些力图将更多的半导体生产迁回本土的地方。

Lasertec生产的最先进半导体光掩模（即在硅片上光刻出电路图形的模板）用检测工具享有近乎垄断的地位。自2020年初以来，该公司股价已飙升三倍，成为亚洲表现最佳的蓝筹股之一。基恩士的精密传感器对于检测半导体表面的缺陷同样不可或缺。

当然，这几家公司的设备在其他行业一样大有用处。为工厂车间生产大型机械臂的发那科长期都是汽车装配线的固定供应商。负责发那科美国业务的迈克·奇科（Mike Cicco）指出，电动汽车的发展要求汽车制造商具备一系列新能力，相应地也就必须部署新型机器人。发那科预计，在福特位于德国科隆的工厂今年转型为福特科隆电气化中心（Ford Cologne Electrification Centre）的过程中，自己将为它提供500台机器人。

事实证明，变得不可或缺会带来丰厚利润。日本这四家工业自动化明星公司都宣称自己的营业利润率超过了20%。其中利润率最高的基恩士甚至超过了50%。在过去三个季度，基恩士公布的净利润不断再创历史新高。与英伟达等芯片公司一样，基恩士并不制造产品，而是设计产品，并协助客户在自家工厂部署它们。Lasertec也很少自己制造产品。这种轻资本的方式有助于保持利润率。基恩士在研发上的支出仅占其净销售额的3%。SMC的这一比例也只有大约4%。发那科倒是自主生产几乎所有的产品，在产能和研发方面也投资更多。但它对投资的利用很高效，尤其是能大量使用自己的机器人来为客户制造机器人，这对一家机器人制造商来说再合适不过了。它最大的“熄灯”工厂可以在现场没有昂贵的人类操作员的情况下运行一个多月。

日本自动化公司的成功一部分也得益于企业文化。SMC旗下的6000名销售员同时也是非常了解客户设备的系统工程师。基恩士的产品销售没有中间商，完全依靠自己的销售团队。和SMC一样，他们中很多人都是工程师，把大量时间花在客户的车间里，找出本可能被忽视的小毛病和需要微调的地方。他们的付出换来的回报也相当可观。据《日本经济新闻》报道，上个财年，基恩士员工的平均工资超过了15万美元。

与所有日本企业一样，自动化明星们对股东往往就没那么慷慨了。它们大多攥着大把现金：基恩士在上个财年持有超过100亿美元的流动资产。这些公司保守的文化和财务上的吝啬已经根深蒂固，以至于一些投资者说，如果这种作派骤然生变，可能是公司有了什么大变化，或许还是不好的那种。

投资者不得不依靠这种雾里看花似的解读，因为这些公司的内部情况并不总是那么透明，至少以当代西方标准秉承的对股东开放的态度来看是这样。正如专注于科技公司的英国资产管理公司柏基（Baillie Gifford）在2020年委婉指出的那样，SMC采用了“日本传统的公司治理方式”，只与股东保持有限的接触。一家持有基恩士股份的资产管理公司称自己从未与基恩士的管理层直接交流过。

随着这些公司变得日益国际化，它们将面临压力，需要变得更加坦率透明，在股东分红和投资两方面也不要再那么抠门。2015年，发那科迫于美国维权对冲基金Third Point的压力，大幅提高了股息。随着日本变得不那么抵触“牛虻”投资者，该国的自动化产业应该会收到更多这样的要求。与此同时，为了保持自己的创新优势，这些公司可能需要大幅提高研发投入。中国与西方的地缘政治冲突冲击了科技产业，促使中国想要在各种先进技术上减少对外国供应商的依赖，包括机器人技术。如果得偿所愿，中国的这种策略会让这些日本公司丧失一个巨大的市场，同时带给它们新的全球竞争对手。变得不可或缺是一回事，能守住这种地位又全然是另一回事了。■



Like smartphones, but lethal

The technology of seeing and shooting your enemies

War among the sensors poses new challenges, says Shashank Joshi

THE WAR which began when Azerbaijan attacked its neighbour Armenia on September 27th 2020 was a bloody affair, with over 7,000 lives lost. The previous war between the countries, which dragged on from 1988 to 1994, had left Armenian forces occupying much of Nagorno-Karabakh, an ethnic Armenian enclave within Azerbaijan. When, in 2020, the guns fell silent after just 44 days, Azerbaijan had taken back three-quarters of the territory those forces had held in and around the enclave—a victory as decisive as any in recent years.

Azerbaijan had some advantages at the outset. It had a larger population and a bigger military budget, far more artillery pieces and a better equipped air force. That said, much of its equipment dated back to the Soviet era, which is to say to that previous war where it had proved ineffective. And it is a military dictum that, other things being equal, an attacker needs a force perhaps three times larger than the one under attack to prevail.

But the Azeris also had a fleet of drones which included TB2s procured from Turkey and Harops bought from Israel. The TB2s, with a wingspan of 12 metres, were remote-controlled, could launch either bombs or missiles, and stayed in the air for up to 24 hours at a time. The Harops were smaller, stealthier, more autonomous and designed for kamikaze attacks on radars. Between them they blew up more than two-dozen air-defence systems and scores of artillery pieces. Hundreds of armoured vehicles were destroyed. A similar bonfire of armour had played out in Syria's Idlib province earlier that year, where Turkey's TB2S obliterated the Syrian tank fleet in a two-day blitz.

Military leaders across the world paid close attention. “The hallmarks of a different form of land warfare are already apparent,” General Sir Mark Carleton-Smith, Britain’s chief of general staff, told a conference which took place a year after the conflict. “Small wars...are already throwing up some quite big lessons.”

The drones themselves were only a part of the curriculum. The rest looked at the command, control and communications systems that gathered information on what needed to be hit, decided priorities and brought them about. Satellite communications let tactical commanders see what the drones saw and feed them targets identified by other means. In Azerbaijan Turkish radar-spotting spy planes seem to have provided some spotting; Turkey’s ground-based KORAL system, which detects and jams enemy radars, helped the tank-busting drones over Idlib.

| *Joo joo eyeball*

This sort of highly networked warfare is something military technologists have been working on for decades. Its true believers imagine a “battlespace”—think of an old-fashioned, seen-through-binoculars, two-dimensional, ships-soldiers-and-tanks battlefield, but extended vertically all the way up to orbit and electronically well out into infrared and radar wavelengths—in which ubiquitous sensors can pass targeting information to all sorts of “shooters” through seamless communication networks.

Huge investments have provided the great powers—pre-eminently, America—and developed-world allies with some of these wished for capabilities. As General Mark Milley, America’s top military officer, put it last year, “You’ve got an ability to see and an ability to hit at range that has never existed before in human history.” Such abilities are likely to matter a lot in some sorts of set-piece conflict. In the wars America has actually been fighting, wars against insurgencies armed with improvised explosive devices (IEDs) and the like, they have proved less of a help.

Now Azerbaijan, a decidedly non-great power, had achieved a similar sort of capability far more cheaply. Similar does not mean truly comparable: a better armed and prepared adversary might have easily seen them off. But that a small war in the Caucasus provided portents of a “transparent battlespace [which is] effectively one giant sensor,” as Sir Mark put it, was still an eye opener.

Telecommunications—semaphore, then telegraph, then wireless—have been letting spotters tell shooters of targets the shooters cannot see for centuries. But the modern notion of creating “kill chains” from a range of sensors to a range of shooters on the fly is widely traced to the 1970s. That was when Soviet military theorists began to talk of what they called the “reconnaissance-strike complex”—a networked system in which, for example, a fighter jet might funnel data on a target it could not attack itself to a cruise missile fired from a warship which could.

| *Phoning it in*

For the culmination of such thinking, consider America’s F-35. As well as sneaking past air defences and dropping precision guided munitions on them and other targets, this strike aircraft also gathers scads of information for others and functions as a giant flying router, channelling data to and from nearby aircraft, other forces in the area and commanders who may be half a world away.

The reconnaissance-strike complex has thus come of age. “Today this cycle—reconnaissance-fire-defeat—is literally tens of seconds,” boasted Major-General Vladimir Marusin, then Russia’s deputy chief of ground forces, in 2015. Still more speed may be available quite soon; hypersonic missiles and speed of light weapons such as laser beams and microwaves are all the rage.

In practice, the time it has taken Russian guns to act on data from Russian

drones during the conflict in Ukraine's Donbas region, the conflict to which General Marusin was referring, has not come down quite as far as it might. But it is short enough to make life on the receiving end ever harder. When Mick Ryan, a major-general who led Australia's defence academy until December, says that, "The ability to link sensors to commanders and to weapons over the last 20-30 years has profoundly changed our conception of time on the battlefield," it is the fighting in the Donbas he is thinking of. In the Gulf war, or for that matter along the Ho Chi Minh trail, there was often most of an hour between being spotted and being on the receiving end of an artillery barrage or airstrike. Now, says General Ryan, "If we think we've been spotted, we have ten minutes—and if we're not gone, we're dead."

As technologies get more affordable they spread. Baykar, Turkey's TB2 maker, has plenty of customers for its drones (see map). More important than the change in who uses such systems, though, may be how they are used. Having a few drones allows you to replace a few planes. Having a lot of drones allows you to do things that were not previously possible, such as establishing wide ranging and persistent surveillance systems. And developments outside the military suggest that the trend towards things getting smaller, cheaper and more numerous has a long way to go.

Over the past decade smartphone engineers have been making a wide range of sensors smaller and less energy-intensive with the sort of well resourced zeal only an industry with revenues in the trillions can command. A \$1,000 phone comes not just with a panoply of cameras pointed in various directions and working at various wavelengths but also with one or more photometers, barometers, accelerometers, hygrometers, magnetometers, gyroscopes and microphones. It also boasts radio antennae that pick up signals from navigation satellites, nearby Bluetooth accessories, payment terminals, Wi-Fi networks and even, now and then, mobile-phone towers.

A remarkable amount of the processing power those sensors and networks need sits right there in the phone. More is to be found in the cloud, where it can be fed into artificial intelligence (AI) systems which plot the best route to take in this evening's traffic, translate from Serbian to Portuguese and recognise your friends in pictures.

Applied beyond the phone these continuously improving technologies make all sorts of wizardry possible. They have, for example, hugely expanded what can be done with small, cheap satellites, as well as with civilian drones. And they can now be built into artillery shells, or into battledress, or just scattered around the combat zones. "I'm going to have to think very hard about how I can get to within three kilometres of an objective," says a British infantry officer who recently completed an exercise involving cheap, off-the-shelf camera technology capable of recognising humans at long ranges.

This report looks at the "intense competition between hiding and finding" these technologies are making possible, to borrow a phrase from the new "operating concept" for Britain's armed forces announced in 2020. It examines newly accessible and newly affordable ways of seeing, and at ways for the data thus collected to be brought together and understood. It also looks at the stealth, electronic warfare, cyber-attacks and other deception which hidiers can use to stay hidden.

| *Come together*

These changes have tactical implications. The trend towards transparent battlespaces may see basic military tenets rethought. Officers drilled in the importance of massing their forces in order to concentrate their firepower will be learning to fight in smaller, more dispersed units. "Mass potentially can be a weakness," warned General Sir Nick Carter, Britain's then chief of defence staff, reflecting on the lessons of Nagorno-Karabakh.

The same may be true of manoeuvre—a principle which, like that of mass, military thinkers hold dear. “These co-evolving concepts, tactics, and commercial and military technologies are once again creating a battlespace in which movement becomes extremely dangerous,” writes T.X. Hammes of America’s National Defence University. “If a unit moves, it will create a signal and can be attacked at much greater ranges than in the past.” In his book “Eyes in the Sky”, Arthur Holland Michel quotes a defence official describing being under wide-area drone-based video-surveillance as like “the scene in ‘Jurassic Park’ where Dr Alan Grant faces down a T. Rex: ‘Don’t move. He can’t see us if we don’t move.’”

The advantage of surprise, idiomatic since the days of Sun Tzu, will become more difficult to achieve at scale. Coups like China’s offensive over the Yalu river in the Korean war, or Egypt’s dazzling strike on Israel in October 1973, will be all but impossible. Russia has tried various tactics to confuse those observing its deployments on Ukraine’s border, including removing unit markings, shuttling convoys back and forth and shutting down trainspotting websites. The brute fact of the build-up is impossible to hide.

Some go as far as to argue that military offensives may no longer be possible against forces that have embraced all that technology now has to offer: to move will be to be seen will be to be shot. Others suggest that the changes may be less marked than worried officers are imagining. Stephen Biddle of Columbia University points out that as early as the first world war, tacticians learnt how to avoid exposing their forces to modern artillery and air power—capabilities as remarkable then as quick sensor-to-shooter kill-chains are today. The basics of concealment and deception can and will be updated for the digital age. “The Armenians made the mistake of not having thought hard enough about this,” says Mr Biddle. “Nobody else is going to make that mistake.” ■



像智能手机，但致命

看见和射杀敌人的技术

沙申科·乔希认为，传感器之间的战争带来了新的挑战【专题《国防技术》系列之一】

阿塞拜疆于2020年9月27日对邻国亚美尼亚发动的血腥战争让7000余人丧生。这两个国家之间的前一场战争从1988年一直持续到1994年，最后亚美尼亚军队占领了阿塞拜疆境内的亚美尼亚族飞地纳戈尔诺-卡拉巴赫（Nagorno-Karabakh，以下简称纳卡）的大部分地区。2020年的枪声在仅仅44天后平息，阿塞拜疆夺回了亚美尼亚部队在该飞地及周边控制的地区的四分之三——近年来这算得上是决定性胜利。

阿塞拜疆从一开始就有一些优势。它拥有更多人口和军事预算，火炮数量远超对手，空军装备也更好。话虽如此，它的大部分装备都源自苏联时代，也就是两国的上一场战争，而那时就已经证明其效力不佳。而且军事上有这么一个说法：其他实力相当的情况下，进攻方部队需要比防御方多三倍左右方能获胜。

但是，阿塞拜疆还有一支无人机部队，其中包括从土耳其采购的TB2和从以色列购买的Harop。TB2翼展12米，遥控，可选择投放炸弹或发射导弹，一次可在空中停留长达24小时。Harop更小更隐蔽，也更自主，专门用于对雷达系统发起自杀式攻击。两种机型总共炸毁了20多个防空系统和大量火炮。数百辆装甲车被摧毁。2020年早些时候，在叙利亚的伊德利卜省也发生了类似的武器交火，土耳其的TB2在为期两天的闪电战中歼灭了叙利亚的坦克部队。

世界各地的军方领导人密切关注进展。“一种不同形式陆战的特征已经清晰地显现了出来，”英国总参谋长马克·卡尔顿-史密斯（Mark Carleton-Smith）将军在那次冲突一年后举行的一次会议上说，“小战争.....已经在给出一些相当大的经验教训。”

无人机本身只是这经验中的一部分。其余那部分关注指挥、控制和通信系统，这些系统收集了关于需要打击什么目标的信息，决定了优先项并实现了它们。卫星通信让战术指挥官看到了无人机看到的东西，也把通过其他方式识别的目标通报给无人机。在阿塞拜疆，土耳其研制的雷达侦察机似乎派上了用场。在伊德利卜，土耳其造陆基KORAL系统探测并干扰敌方雷达，协助无人机摧毁坦克。

| 魔力眼珠

军事技术人员研究这种高度网络化的战争已经有几十年了。它的忠实拥护者构想了一个“作战空间”：想象一个老式的、透过双筒望远镜看到的二维的战场图景，里面有舰队、士兵和坦克，然后把它垂直延伸，一直延伸到太空轨道，再做电子层级的扩展，进入红外线和雷达波长。在这个空间里，无处不在的传感器可以通过顺畅无阻的通信网络将目标信息传递给各种各样的“射击手”。

巨额投资已经让大国（尤其是美国）和发达国家盟友部分实现了这些梦想的战斗能力。美国最高军官马克·米利（Mark Milley）将军去年是这么说的：“你拥有了人类历史上前所未有的视觉和远距离打击能力。”这样的能力在某些类型的双方都有准备的“会战”中很可能会很重要。而在美国实际进行着的战争中，也就是在对付使用简易爆炸装置（IED）等武器的叛乱分子的战争中，事实证明它们的帮助没那么大。

如今，显然不是大国的阿塞拜疆却以低得多的成本获得了类似的能力。“类似”并不意味着真的具有可比性：一个装备更好、准备更充分的对手或许很容易就把他们击退。但是，高加索地区的一场小型战争预示了一个——用马克爵士的话说——“相当于一台巨型传感器的透明的作战空间”，这仍然叫人大开眼界。

几个世纪以来，从旗语到电报，再到无线的通信方式让侦察员能把射击手看不到的目标通报给他们。但是，现代“杀伤链”的概念——从一系列传感器即时传输给一系列射击手——被普遍认为源于1970年代。那时，苏联的军事理论家开始谈论他们所谓的“侦察-打击综合体”，在这个网络化的体系

中，举例来说，一架战斗机或许会将自己无法直接攻击的目标的相关数据传输给能够发起这一攻击的舰载巡航导弹。

| 轻松传输

美国的F-35是这种思路的巅峰之作。这种攻击机会偷偷飞越防空系统，向这些系统及其他目标投掷精确制导弹药，此外也为其他人员和设备收集大量信息，并充当一个巨大的飞行路由器，让数据在自己和附近的飞机、本地的其他部队，以及可能远在半个世界以外的指挥官之间来回传输。

因此侦察-打击综合体已经成熟。2015年，时任俄罗斯地面部队副参谋长的弗拉基米尔·马鲁辛（Vladimir Marusin）少将夸口说，“今天这个‘侦察-开火-击败’的周期真的不过几十秒。”很快可能还会提速。高超音速导弹以及激光束、微波等光速武器风头正盛。

在实战中，在乌克兰顿巴斯地区的战争（也就是马鲁辛少将所说的那场）期间，俄罗斯的枪炮基于俄罗斯无人机提供的数据采取行动的耗时并没有达到预期最佳水平。但也已经足够短到让受袭方的处境雪上加霜。担任澳大利亚国防学院院长至去年12月的米克·瑞恩（Mick Ryan）少将说，“过去二三十年里，将传感器与指挥官和武器连接起来的能力已经深刻改变了我们在战场上的时间观念。”此时他脑子里想到的就是顿巴斯的战争。在海湾战争中，或者在胡志明小道上，从被发现到被炮击或空袭通常有将近一个小时的时间。现在，瑞恩说，“如果我们认为自己被发现了，我们有十分钟时间——十分钟内不离开就死定了。”

随着技术变得更便宜，它们传播开来。土耳其的TB2制造商Baykar的无人机有很多客户（见地图）。不过，比起谁使用这些系统，或许更重要的变化在于它们如何被使用。拥有几架无人机可以让你替换掉几架飞机。拥有大量无人机可以让你做以前做不到的事，比如建立覆盖广泛且持续不断的监视系统。而军事部门以外的发展情况表明，武器变得更小、更便宜和更众多的趋势还有很长一段路要走。

过去十年中，智能手机工程师一直在制造各种尺寸更小，能耗更低的传感

器，这种热情的背后是唯有一个拥有数万亿美元收入的行业才能掌握的充裕资源。一部1000美元的手机不仅配备一整套指向不同方向并针对不同波长的摄像头，还配备一个或多个光度计、气压计、加速度计、湿度计、磁力计、陀螺仪和麦克风。它还配有无线电天线，可以接收来自导航卫星、附近的蓝牙配件、支付终端、Wi-Fi网络的信号，甚至时不时还能连上手机信号塔呢。

这些传感器和网络所需的处理能力有相当大一部分就存在于手机中。更多的处理能力可以在云端找到，在那里数据可被输入人工智能（AI）系统。系统会找出今天傍晚的最佳交通路线，把塞尔维亚语翻译成葡萄牙语，在照片中找出你的朋友。

把这些不断改进中的技术应用到手机之外，就让各种魔法成为可能。例如，它们极大地扩展了廉价小型卫星和民用无人机的功能。而且，它们现在可以被安装在炮弹里，或者嵌入军服中，或者就直接散布在战区各个角落。“我得要绞尽脑汁地想怎么能进入目标的方圆三公里内。”一名英国步兵军官说。他最近完成的一项演习用到了廉价、现成的摄像头技术，能够远距离识别人员。

本专题报道审视因这些技术而正在实现的“隐藏和发现之间的激烈竞争”——这是2020年宣布的英国武装部队新的“作战概念”中的一个表述。它将探讨新近实现的、新近变得廉价的发现方式，以及将由此收集到的数据汇总并理解它们的方式。它也会研究让隐藏者可用于继续隐身的秘密的电子战争、网络攻击和其他欺骗手段。

| 一起来吧

这些变化具有战术意义。向透明的作战空间转变的趋势可能会让基本军事原则被重新审视。一直以来，军官们接受的训练强调集结部队以集中火力的重要性，现在他们将学习以更小、更分散的单位作战。“大规模有可能是一个弱点。”在评述纳卡地区战争的教训时，英国时任国防参谋长尼克·卡特（Nick Carter）将军警告说。

机动性可能也一样——这是军事思想家除规模之外珍视的另一个原则。“这些共同演变中的概念、战术以及商业和军事技术正再度创造一个让移动变得极其危险的作战空间，”美国国防大学的T.X.哈姆斯（T.X. Hammes）写道，“如果一个单位移动，它将产生一个信号，然后可能会遭到来自比过去远得多的地方的袭击。”亚瑟·霍兰德·米歇尔（Arthur Holland Michel）在他的《天空之眼》（Eyes in the Sky）一书中引用了一位国防官员的话，说处于广域的基于无人机的视频监控之下，就像“《侏罗纪公园》中艾伦·格兰特博士面对一只霸王龙时的场景：‘别动。我们不动，它就看不到我们。’”

自孙子的时代以来惯用的“突袭”战术将更难大规模实施。像中国在朝鲜战争中跨过鸭绿江，或埃及在1973年10月对以色列发起的令人眼花缭乱的袭击等行动将几乎再无可能上演。俄罗斯尝试了各种策略来迷惑那些观察它在乌克兰边境部署军队的人们，包括移除分队标记、让车队来回穿梭，关闭火车监测网站等。但集结的赤裸裸的事实是无法隐藏的。

一些人甚至认为，一旦敌方拥抱了今天技术所能赋予的全部能力，要对其发动军事进攻或许再无可能，因为只要移动就会被发现，被发现了就会被射杀。其他人则认为，变化可能不像忧心忡忡的官员们想象的那么大。哥伦比亚大学的斯蒂芬·比德尔（Stephen Biddle）指出，早在第一次世界大战时，战术家们就学会了如何避免将部队暴露在现代火炮和空中力量之中——在当时，这类力量就和今天“从传感器到射击手”的高速杀伤链一样强大。隐藏和蒙骗的基本方法可以也将会为数字时代而升级。“亚美尼亚人犯了一个错误，就是没有足够认真地考虑这一点，”比德尔说，“其他人都不会再犯这个错误了。”■



All the targets, all the time

Synthetic-aperture radar is making the Earth's surface watchable 24/7

Cloud cover and the dark of the Moon matter no more

THE FIRST time that humans observed a battlefield from a celestial vantage point was in June 1794, scarcely a decade after the Montgolfier brothers had invented the hot-air balloon. The French Aerostatic Corps, a motley crew of chemists, carpenters and hangers on (sometimes literally), flew a tethered hydrogen balloon, l'Entreprenant, over the battlefield at Fleurus, in what is now Belgium. The spotters on board informed their comrades down below about the disposition and movements of their Austrian enemies by semaphore. France won the battle.

The success was not in itself trendsetting. When France, Britain and Prussia met 21 years later at Waterloo, 30km north of Fleurus, no one looked down but the birds: Napoleon had abolished the Aerostatic Corps in 1799. Military ballooning did not really come into its own until the American civil war, and its importance was short lived. When war returned to the low countries in 1914 the balloon was already beginning to give way to the aeroplane; by the end of the war it had been completely eclipsed. By the time NATO moved its military headquarters to Mons, 40km west of Fleurus, in the 1960s, satellites had entered the picture.

Yet even as the method of elevation changed, the means of sensing did not. What struck the retinas of the French balloonists—visible light—was the same thing that struck the film of the panoramic cameras aboard America's first spy satellites. Film sensitive to the near infrared has sometimes been used to differentiate camouflage (which until recently tended not to reflect those wavelengths) from foliage (which reflects them strongly). Satellites built to spot the launch of ballistic missiles do so by picking out the longer infrared wavelengths associated with hot rocket exhausts. But most

systems for looking down from orbit have relied mostly on visible light.

This has two obvious problems when you are looking down from orbit: night and cloud. Half the world is in darkness at any given time. Most of it is sometimes cloudy and some of it is nearly always cloudy. More than half of Europe is typically obscured at any given time and in parts of South America cloud-free images only appear every decade or so, according to Adam Maher of Ursa Space, a startup based in Ithaca, New York, which uses satellite pictures for business intelligence. Planet, a company which aims to take one-metre resolution pictures of the entire land surface every day, says that about 70% of the surface is cloudy at any one time. Soldiers, sneaky as they are, have been moving troops and equipment under cover of inclement weather for decades.

In the past few years, though, an alternative to visible wavelengths has been making enormous strides. The satellites from which Ursa draws its images are built around radio antennae, not lenses. These orbiting radars illuminate the surface using wavelengths hundreds of thousands of times longer than those of visible light. Such wavelengths pass easily through clouds, fog, smog and, when necessary, camouflage netting before hitting the surface and bouncing back out into space.

The advantages long wavelengths offer in terms of penetration come with compensating drawbacks. The resolution a sensor depends on the wavelength and on the size of its aperture—the mirror or lens in the case of a camera or a telescope, the antenna in a radar. If you lengthen the wavelength, you increase the size of the aperture you need in order to achieve a given resolution. To produce detailed images with radar requires a very large aperture indeed—far larger than anything a single spacecraft can offer.

Synthetic-aperture radar (SAR) provides a way round that problem.

Satellites move at quite a clip—typically, in low orbit, around 25,000kph. By taking all the echoes a radar satellite gets from a given target as it passes over it—and processing them into a single image, SAR produces a result as precise as if it had been made using a single aperture as wide across as the distance the satellite travelled while gathering the data—tens of hundreds of kilometres (see diagram).

This technology has been available since the 1960s, and used by spy satellites since the 1980s. But it was limited, expensive and highly classified. It was not until the late 2000s, when India and Israel both had military SAR satellites of their own that America's National Reconnaissance Office, an arm of the Pentagon, declassified the existence of its own such satellites, finally allowing its employees to talk to Air Force officers about them. Civilian space agencies in America, Canada and Europe used the technology for various environmental missions, but not as a routine way of looking at human activities. It was simply too expensive.

Advances in electronics, spacecraft engineering and on-orbit computation mean it is now possible to put SAR systems with resolutions of a few metres or less onto small satellites at a reasonable price. In 2018 two startups, Capella Space, in California, and ICEYE, in Finland, launched commercial SAR satellites, and the field is now booming. Realising that trying to stop the boom would be pointless, as other countries have similar capabilities anyway, the Pentagon has encouraged it—in part because it greatly increases its own capacities.

| *Kings of heaven*

Jack O'Connor, who retired from America's National Geospatial-Intelligence Agency in 2013, says that back when everything was classified the amount of available SAR coverage was not sufficient for the sort of analysis that is now normal. More for everyone means more for the spooks. "If you're in a professional intelligence agency, now you have additional sources and you

can check the orbits to see do they give me coverage at times and in places I couldn't get before?"

Though intelligence agencies and armed forces tend not to brag about what this makes possible, others are happy to. Russia has been testing a nuclear-powered cruise missile which NATO calls "Skyfall" at facilities in the Novaya Zemlya archipelago, high up above the Arctic Circle. And as the "Arms Control Wonk" podcast put it in the title of an episode last September, "It's always cloudy in Novaya Zemlya". The episode was about the way that Jeffrey Lewis of the James Martin Centre for Nonproliferation Studies at the Middlebury Institute of International Studies at Monterey and his colleagues had used SAR images provided by Capella to show that new tests of the system were being prepared. American intelligence sources subsequently confirmed to CNN that they, too, had clocked the preparations.

The ability to see through poor weather, day or night, lends itself to tracking things that are changing over time. A military build-up like that on the border of Ukraine is the perfect target; the imagery may not be sharp enough to identify the specific type of tank, but it is good enough to count the number of them.

And changes at a specific site can be analysed with remarkable precision. Radar systems can get data from the phase of the waves they are using in ways that optical systems using ambient light cannot. The "coherent change detection" this allows can show up even minute anomalies. When America discovered that it was losing more of its soldiers in Iraq and Afghanistan to roadside IEDs than any other type of weapon, boffins at Sandia National Laboratory, one of the facilities responsible for America's nuclear weapons, developed Copperhead, a drone-mounted SAR system that used this sort of change detection to spot tiny disturbances in the soil where insurgents might have buried IEDs or the command wires that

triggered them. Similar techniques allow satellites to reveal the slight surface subsidence which comes with the building of tunnels for nuclear tests.

Detecting very subtle changes over time is useful for intelligence applications. Detecting blatant ones as they happen is useful for war-fighting ones. Assessing whether bombs have struck the correct targets and what damage they have brought about needs to be done as quickly as possible, lest the other side clean up or obscure the site. India used its burgeoning fleet of SAR satellites for just this purpose after an air strike on Pakistan in February 2019. America's air force did the same thing in tests carried out in December 2020, pointing explicitly to weather conditions in Europe and the Pacific as the motivation.

| *Dwellers all in time and space*

Being able to see a site on a regular basis regardless of the weather also allows armed forces to create archives which will only come into their own in the future. A good example comes from another system the Pentagon developed to counter IEDs: "Gorgon stare" allowed aircraft to take near-continuous video of whole cities over weeks and months. The idea was that, after an attack, it would be possible to run back the tape, as it were, to see when the IED had been emplaced and to trace members of the insurgent group responsible. In principle, SAR archives could provide an analogous ability to turn back the clock in light of new data for select sites all around the world.

Payam Banazadeh, the founder of Capella, says that with the six satellites his company now has in orbit it can check in on any spot on the planet every six hours. The company's planned 40-satellite constellation is intended to get that revisit time down to no more than 15 minutes—less time than it would take for a country to launch a ballistic missile, Mr Banazadeh notes. The satellites cannot operate 24/7: their power-hungry

antennae take their sustenance from solar panels, and their batteries are not large enough for them to operate continuously at night. But they do pretty well. The growth of ICEYE, which is currently operating 14 SAR satellites, Capella and other companies means the number of satellites available is rising rapidly, reducing gaps in coverage. All these companies have military customers.

The time it takes to get the information down from space and into the hands of those who need it is also falling quickly, as big data companies like Amazon Web Services pile into the market and expand the number of ground stations. In five years it will be possible to request an image, communicate with the satellite and receive the product in minutes, says Joe Morrison of Umbra, a California firm which launched its first SAR satellite last June. “You’ll snap your finger and in that same hour you’ve got 25-centimetre resolution imagery—maybe 15-centimetre if it’s a US government national-security use case.”

Umbra hopes to nurture the growth of a downstream industry that could sell analysis based on SAR data to civilian and government customers by making those data cheaper than the optical equivalent offered by companies like Planet and Maxar, an Earth observation company based in Colorado. It plans to sell images covering 16 square kilometres at a resolution of one metre—good enough to make out a car—for \$500 a time under a Creative Commons licence which lets buyers do as they please with the product. The current price of an optical image of equivalent granularity would be around six times as much, and be sold under restrictive conditions that limit how it could be disseminated and used, he says. Such competition should drive down the price all round—and increase the scope for adding all sorts of value.

Huge amounts of satellite images at relatively low prices provides a pretty much ideal input for the sort of machine-learning algorithms that have

powered recent advances in AI: lots of well structured data with which to learn how to recognise all sorts of different things. Such automation allows both new insights and analysis at scale. Mr Maher of Ursa says that his firm might check in on 20,000 facilities once a week for a single client. “It’s less than a full-time job for one person to monitor those sites,” he says.

The capabilities of SAR are just one example, albeit a dramatic one, of the sort of progress being made with all sorts of advanced sensors and the data-processing systems needed to interpret their output. Satellite providers of optical images, hyperspectral data and radio-location services which keep tabs on aircraft and ships are springing up around the world. The ability to use radar to track moving objects from space in real time is getting closer. And pretty much everything which can be done from orbit can also be done with drones closer to the target and capable of responding to new requests almost instantly. There are few places, if any, on the surface of the Earth that are free from such snooping. Below the surface of the seas, though, there is still a redoubt—for now. ■



所有目标，时时刻刻

合成孔径雷达正在使地球表面变得全天候可见

云层覆盖和夜的黑暗都不再是问题【专题《国防技术》系列之二】

人类第一次从天空中的有利位置观察战场是在1794年6月，当时距蒙戈尔菲耶（Montgolfier）兄弟发明热气球不过十年。由化学家、木匠和随从跟班等五花八门的人员组成的法兰西热气球部队（French Aerostatic Corps）在弗勒鲁斯（Fleurus，现属比利时）的战场上空放飞了一个用绳子系在地上的氢气球“进取者号”（l'Entreprenant）。气球上的观察员用旗语向下方的战友通报了奥地利敌军的部署和动向。法国赢得了这场战役。

这次成功本身并没有引领潮流。21年后，当法国、英国和普鲁士的军队在弗勒鲁斯以北30公里处的滑铁卢相遇时，从天上往下看的只有鸟儿——拿破仑在1799年解散了热气球部队。军用热气球要到美国内战时才大展拳脚，而且它的重要性转瞬即逝。当战争在1914年回到低地国家时，气球已开始被飞机取代；到战争结束时它的风头已被蚕食殆尽。到1960年代北约把军事总部迁至弗勒鲁斯以西40公里的蒙斯（Mons）时，卫星已经进入了视野。

然而在升空的方法发生变化的同时，传感的方式并没有改变。击中法国热气球飞行者的视网膜的，和击中美国第一颗间谍卫星搭载的全景相机的胶片的是同一样东西——可见光。对近红外光敏感的胶片有时被用来区分隐蔽伪装（直到最近，这类伪装一般都不反射这些波长）和树叶（强烈反射）。专门用于探测弹道导弹发射的卫星能捕捉到火箭的高温尾焰带有的较长红外波长。但大多数从轨道俯瞰的系统大体上都依赖可见光。

这就使得从轨道俯瞰存在两个明显的问题：夜晚和云。在任何时间点，世界的一半都处于黑暗中。世界的大部分地区时而多云，有些地方几乎永远多云。欧洲一半以上的地区通常在任何时间都被云遮蔽，而在南美洲部分地区，没有云遮蔽的图像每隔十年左右才会出现一次，创业公司Ursa Space的亚当·马赫（Adam Maher）表示。这家位于纽约州伊萨卡城

（Ithaca）的公司使用卫星图片收集商业情报。Planet公司的目标是每天为整个陆地表面拍摄分辨率一米的照片，它表示在任何时候陆地表面的大约70%都是多云的。几十年来，行动隐秘的士兵一直都在恶劣天气的掩护下移动人员和装备。

不过，过去几年里，一种可见波长的替代品取得了巨大的进步。Ursa公司用于绘制图像的卫星是围绕无线电天线而非摄像镜头建造的。这些在轨道上的雷达使用比可见光长几十万倍的波长“照亮”地表。这样的波长很容易穿过云、雾、烟雾，必要时还可以穿过伪装网布，然后撞击地表并反射回太空。

长波长具有在穿透方面的优势，但缺点也随之而来。传感器的分辨率取决于波长和孔径的大小——“孔径”在照相机或望远镜中是镜子或镜头，在雷达中则是天线。如果你延长波长，就增加了达到特定分辨率所需的孔径大小。用雷达生成详尽的图像着实需要一个非常大的孔径——远远大于单个航天器所能提供的设备尺寸。

合成孔径雷达（SAR）提供了一种解决方案。卫星以相当快的速度移动——通常在低轨道上约为每小时25,000公里。SAR获取一个雷达卫星在扫过特定目标时获得的所有回波，将它们加工处理成单张图像，其精度就等同于使用了单个超大孔径——大到等于这颗卫星获取所有这些数据所跨越的距离，也就是几千公里（见图表）。

这项技术自1960年代以来就已存在，自1980年代以来被间谍卫星所运用。但它受限、昂贵，且高度机密。直到2000年代末，当印度和以色列都已拥有自己的军用SAR卫星时，五角大楼下属美国国家侦察局（NRO）才将自己拥有此类卫星的事实解密，终于允许其雇员和空军官员讨论它们。美国、加拿大和欧洲的民用航天机构把这项技术应用于各种环境任务，但没有用作观察人类活动的一种常规化方式。它实在太贵了。

随着电子学、航天器工程和在轨计算取得进步，现在已经可以以合理的价格将分辨率不超过几米的SAR系统安装到小型卫星上。2018年，加州的

Capella Space和芬兰的ICEYE这两家创业公司发射了商业SAR卫星，目前这个领域开始蓬勃发展。五角大楼意识到试图阻止这种繁荣没有意义，因为无论如何其他国家都拥有类似的能力，遂开始鼓励它的发展——一部分原因是它已经极大地提高了自己的能力。

| 天上诸神

2013年从美国国家地理空间情报局（NGA）退休的杰克·奥康纳（Jack O'Connor）说，当一切都还是机密时，SAR的覆盖范围不足以开展如今已变成常态的那类分析。向更多人开放让情报人员也拿到了更多信息。“如果你在专业情报机构，现在你有了更多信息源了，你可以查看下轨道，看看那些以前没有图像的时间段和地点现在是不是有了？”

尽管情报机构和武装部队通常都不会大声嚷嚷这种能力能够做什么，其他人却乐于吹嘘。俄罗斯一直在位于北极圈内的新地岛的设施中测试一种核动力巡航导弹，北约称之为“天陨”（Skyfall）。正如播客“军备控制狂”（Arms Control Wonk）在去年9月的某一集的标题中说，“新地岛总是云层密布”。这一集讲述了明德大学蒙特雷国际研究学院（Middlebury Institute of International Studies at Monterey）的詹姆斯·马丁防核扩散研究中心（James Martin Centre for Nonproliferation Studies）的杰弗里·刘易斯（Jeffrey Lewis）及其同事如何利用Capella公司提供的SAR图像，发现俄罗斯正在准备对“天陨”的最新测试。美国情报部门的消息人士随后向CNN证实，他们此前也已注意到了这个动态。

有了无论白天黑夜不受天气干扰的“穿透”视觉，自然就很适合跟踪随时间变化的事物。像在乌克兰边境那样的军事集结就是完美的目标。图像可能不够清晰，无法识别坦克的类型，但足以数出它们的数量。

而且还可以非常精确地分析某个特定位置发生的变化。雷达系统可以从它们所用的波的相位中获取数据，是使用环境光的光学系统做不到的。由此生成的“连贯变化检测”甚至可以发现微小的异常。当美国发现它在伊拉克和阿富汗的士兵因路边IED丧生的人数多过其他任何类型的武器时，负责美国核武器的机构之一桑迪亚国家实验室（Sandia National Laboratory）

就研发了一种无人机载SAR系统Copperhead。它使用这种连贯变化检测来发现土壤中的细微动静，显示叛乱分子可能在这些地方埋了IED或其触发装置。类似的方法让卫星可以发现因建造核试验隧道造成的轻微地表沉降。

探测随时间推移而发生的非常细微的变化有助于情报工作，而能实时探测到公开、明显的变化则有助于作战。评估炸弹是否击中正确目标以及造成何种破坏需要尽快完成，以免敌方清理或掩盖现场。在2019年2月空袭巴基斯坦之后，印度就将其快速扩大的SAR卫星群用于此目的。美国空军在2020年12月也做了这方面的测试，并明确表示欧洲和太平洋的天气状况是它使用这项技术的原因。

| 全部身处时空中的居民

无论天气如何都能频繁查看一个地点，这也让武装部队得以创建只会在未来显现用处的档案。一个很好的例子是五角大楼为对抗IED而开发的另一个系统“戈尔贡凝视”（Gorgon stare），它让飞机在数周和数月内对整个城市拍摄近乎连续不断的视频。其想法是，在袭击发生后，可回放视频来查看IED在何时被埋放，并追踪背后的叛乱组织成员。原则上，SAR档案也可以提供类似的能力，基于新数据来让遍布世界的特定地点“时光倒转”。

Capella的创始人帕亚姆·巴纳扎德（Payam Banazadeh）说，凭借公司目前在轨道上的六颗卫星，它可以每六小时查看一次地球上任何地方。巴纳扎德指出，公司规划中的40颗卫星的星群意图把重访问隔时长缩短到15分钟以内——快过一个国家发射一枚弹道导弹的时间。这些卫星无法全天候运行：它们非常耗电的天线从太阳能电池板中获取能量，而它们的电池不够大，不足以在夜间连续运行。但它们已经做得很不错了。目前运营着14颗SAR卫星的ICEYE，以及Capella和其他公司的扩张意味着可用卫星的数量正在迅速增加，缩小了覆盖缺口。所有这些公司都有军事客户。

随着亚马逊AWS等大数据公司涌入市场并扩大地面站的数量，将信息从太空传送到需要它们的人手中的耗时也在迅速缩短。于去年6月发射了第一

颗SAR卫星的加州公司Umbra的乔·莫里森 (Joe Morrison) 说，不出五年，你将可以请求一张图像，与卫星通信，然后在几分钟内收到它。“你打个响指，在同一个小时内，你拿到了分辨率25厘米的图像——如果是美国政府用于国家安全用途，分辨率可以是15厘米。”

Umbra希望降低SAR数据的售价，要比Planet和科罗拉多州的地球观测公司Maxar出售的光学数据更便宜。它希望能以此促进下游产业的发展，这个产业可以把基于SAR数据的分析出售给民用和政府客户。它计划在知识共享许可协议（CC协议）下，以500美元一次的价格出售覆盖16平方公里、分辨率一米的图像（足以发现一辆车），该许可让买家可以随心所欲地使用图像。他说，目前同等精度的光学图像售价约六倍，并且带有传播和使用方式限制条件。这样的竞争应该会全面压低价格，并增加各种增值空间。

以相对低廉的价格获取海量卫星图像为在近年推动了人工智能（AI）发展的那类机器学习算法提供了一种非常理想的输入：大量结构良好的数据，可用于学习如何识别各式各样的事物。这种自动化让大规模的新见解和分析都成为可能。Ursa的马赫说，他的公司可能为单个客户每周查看一次两万个设施。“监控这些地点都用不了一个全职工。”他说。

SAR的能力只是一个例子——尽管令人印象深刻——显示了各种先进传感器和诠释其输出所需的数据处理系统正取得的进展。各种各样的卫星服务供应商——提供光学图像、超光谱数据，以及追踪飞机和船舶的无线电定位服务——正在世界各地涌现。可以使用雷达从太空实时跟踪移动物体的那一天也越来越近。几乎所有可在轨道上完成的事，也可以通过更靠近目标并能几乎立即响应新请求的无人机来完成。地球表面极少有地方免于这种窥探。不过，在海面之下仍有一个堡垒——也仅就目前而言。■



Lots of signal, lots of noise

Where to process data, and how to add them up

The dark art of data fusion

“YOU COULD put forward a thesis that Afghanistan was the most densely surveilled battlespace in the history of humankind,” says Mick Ryan, until recently the head of Australia’s defence college. “And that didn’t seem to help us.” For an information advantage to change the course of a war you need more than just a cornucopia of sensors; you need ways to combine their data into information that can be acted on at speed.

Take radar, a technology which changed the course of the war in which it made its debut more than any other new sensor in history. It had applications from the finding of submarines (via their snorkels) to the proximity fuses which made artillery and anti-aircraft rounds more lethal. As its developers used to grumble when nuclear physicists were lauded for their godlike power, “Radar won the war; nuclear weapons just ended it.”

But radar’s capabilities had to be built into systems that made use of them. The canonical example is the air-defence system used during the Battle of Britain. Its radars were linked to a network of radio receivers, barrage balloons, fighter planes and human spotters through a network of phone lines. The resulting reports were plotted on a map and used to guide fighter planes to their targets with spectacular success.

Over the past decade efforts to embody similar feats of collective intelligence in AI systems have made real progress. In a recent exercise in Poland, the British Army experimented with a command and control system built over eight weeks in collaboration with Anduril, a California-based company which provides both sensors and systems to fuse their data. The system did not just spot targets; it also worked out the closest

suitable aircraft that could be used to attack them and presented its results to the force's commanders in the form of clearly delineated options.

This far outperformed the old way of doing things; options for hitting targets were delivered 30 minutes quicker, according to an officer involved in the experiment. And it required a team of just five people, rather than the 25 it used to take. The officer compares the improvement to that offered by satellite navigation with real-time traffic updates. "It's like going from an A-Z...to Waze. You're operating at a ridiculously different speed."

Joseph Votel, a recently retired head of the Pentagon's Central Command, said last year he was struck by how Israeli forces mounting strikes on Gaza in May had been integrating AI into their operations and by "the impact that is having on their targeting cycles". He says Israel is using AI to generate a large range of potential targets for surveillance to whittle down. This lets its forces "disrupt enemy attacks without the need for a lengthy development period or a longer campaign."

America's armed forces, helped by Palantir (an AI company which, like Anduril, takes its name from "The Lord of the Rings") and other contractors, is trying to build such technology into a system which can narrow down a huge range of potential targets and pass information about them freely to where it is most needed. Given the finite capacity of communication systems, not to mention the vulnerability, this requires that an increasing amount of processing be done "on the edge"—that is, on the platform carrying the sensor.

In 2016 a Pentagon project called Maven started trying to address the "lots of surveillance but not much to show for it" problem identified by General Ryan. The idea was to automate the identification of people and objects in the petabytes of video footage sent back by surveillance drones. It ended up producing software efficient enough to run on the drones themselves. In

Scarlet Dragon, a recent- AI focused American exercise in which a wide range of systems were used to comb a large area for a small target, things were greatly speeded up by allowing satellites to provide estimates of where a target might be in a compact format readable by another sensor or a targeting system, rather than transmitting high-definition pictures of the sort humans look at.

In a world where bandwidth is often the biggest constraint such parsimony is a boon. It speeds up kill chains while reducing vulnerability to jamming. At the same time, it puts a greater burden on the automated parts of the system to provide reliable synopses of what they see, which is a worry for people keen to ensure that fully informed and responsible human beings stay on top of all decisions about where and when to blow things up.

| *Reforging the shards*

However much edge processing may whittle down individual flows, though, the ability for sensors to proliferate and the hunger for more knowledge elsewhere in the system will still mean that command systems need a greater capacity for handling data in bulk. That is why armed forces are spending heavily on cloud-computing services provided by big tech companies to increase their data-handling capacity. In 2019 the Pentagon awarded Microsoft a \$10bn contract for its Joint Enterprise Defence Infrastructure (JEDI). Last year Amazon, which has been supplying the CIA with such services since 2013, got the contract annulled. A new tender issued in November will probably see the work shared among a number of firms. There will be more than enough to go around.

Clouds offer advantages in speed, scale and flexibility. They also help with “data fusion”—combining different pieces of information to reveal things that one source cannot capture, including things no human would think to look for. “You’ll be amazed at the patterns it picks up when you put bulk data together from different sources and run AI algorithms across them,”

says an official familiar with Odyssey, a cloud-computing system being developed by the British armed forces.

Fusion is not just about adding things up; subtraction matters too. In a presentation last year, Brigadier-General Paul Murray put on screen the radar picture available to the North American Aerospace Defence Command (NORAD) on the afternoon of April 15th 2015. It looked like a canvas at which someone had hurled a bucket of blue paint. Somewhere within the mess was the flight path of Doug Hughes, a postman from Florida who had taken it on himself to deliver letters of protest to America's Congress by flying his gyrocopter from Gettysburg to the lawn of the Capitol. Whatever impact this may have had on the legislature, his ability to cross highly restricted airspace unnoticed alarmed NORAD.

Mr Hughes's approach was not entirely undetected. But it was captured only intermittently, and amid everything else going on a human looking at the data at the time concluded that it was innocuous. When a system called Pathfinder fused the relevant data from more than 300 sensors and used AI to remove the clutter, though, the errant aircraft's path stood out clearly.

| *To rule them all*

Pathfinder's decluttering uses commercial flight plans and weather reports to help sort things out; the integration of such open-source data is crucial to a lot of intelligence and surveillance. Last year America's National Security Commission on AI, chaired by Eric Schmidt, a former CEO of Google, said that the country's intelligence agencies would need to build "a continuous pipeline of all-source intelligence analysis" into "continually learning analytic engines". The results, it hoped, would be insights "beyond the current limits of unaided human cognition". Call it Omniscient Neural-net Engineering for Reconnaissance, Intelligence and National Goal-achievement, or ONERING for short.

Some workers at tech companies do not like the idea of being involved in such things. In 2017 thousands of Google employees signed a letter outlining their unhappiness with the company's role in the Maven project. Microsoft's bid for the JEDI contract faced internal opposition on similar grounds. Many others will also have concerns about data fusion on such a scale, for military or any other purposes.

They might take some comfort, at least for the time being, from the fact that seamlessness is much more easily wished for and invested in than achieved. Different military services and agencies contracting with different companies to build their own clouds and AI systems just the way they want them will be likely to produce the digital equivalent of Babel after God smote it. Military organisations, accustomed to laying out their requirements years in advance and in excruciating detail, are ill-equipped for a world in which computing power has become a subscription service and in which new software can transform the hardware it is running on.

The old-school defence contractors who tend to get tasked with integrating the data are “shockingly bad and wildly insecure”, according to Oliver Lewis of Rebellion Defence, an AI provider. “They often use an industrial-era approach designed for building tanks and aircraft that makes it impossible for them to write great software.” Interoperability often requires a level of commercial and technical finesse rarely seen in the management of government contracts. “Defence procurement,” says one AI executive, “is currently fundamentally incompatible with this new model.”

It is not just that the technology is changing, the business environment unfamiliar and large-scale systems integration always hard—particularly so, it often seems, for governments. The systems which fuse and interpret large amounts of data from disparate far-flung sources have to be robust not just in everyday operation but when adversaries are trying very hard to break them down. When it comes to the crunch, the enemy gets a say, too.





大量信号，大量噪音

在哪里处理数据，以及如何汇总它们

数据融合的黑暗艺术【专题《国防技术》系列之三】

“你可以提出一个论点，说阿富汗是人类历史上被最密集监视的作战空间，”最近刚刚卸任澳大利亚国防学院院长的米克·瑞恩（Mick Ryan）说，“而这一点似乎并没有帮到我们。”要获得改变战争进程的信息优势，你需要的不仅仅是大量的传感器；你需要有办法将它们的数据汇总起来，变成可以指导快速行动的信息。

以雷达为例，这种技术首次亮相时，对那场战争的进程的影响比历史上任何其他新传感器都要大。它的应用范围从发现潜艇（通过它们的通气管），到使火炮和防空炮弹更具杀伤力的近距离引信。每当核物理学家被称赞拥有上帝般的力量，雷达的研发者就抱怨说：“雷达赢得了战争；核武器只是结束了它。”

但是雷达的功能必须内置到使用它们的系统中。典型的例子是不列颠战役期间使用的防空系统。它的雷达通过电话线网络与一个由无线电接收器、防空气球、战斗机和人类侦察员组成的网络相连接。生成的报告被绘制在地图上，用于引导战斗机飞向目标，取得了惊人的成功。

过去十年间，在人工智能（AI）系统中让集体情报以类似的方式立功的努力取得了实实在在的进展。在波兰最近的一次演习中，英国陆军试验了一套在八周内搭建起来的指挥和控制系统，这项工作是与总部位于加州的Anduril公司合作完成的，该公司提供传感器和融合数据的系统。这套系统不仅可以发现目标，还能计算出最近的适于发动攻击的飞机在哪里，并把各种选项清晰地圈画出来，呈现给部队指挥官。

这比以前的方式要好得多。据参与试验的一名军官说，找出适合执行攻击任务的选择所需的时间缩短了30分钟。而且它只需要5个人的团队，而不是过去的25人。这名军官把这项改进比作带实时路况的卫星导航。“这就

像从纸质地图变成.....位智（Waze）地图。那运行速度真是天上地下。”

最近退休的前五角大楼中央司令部负责人约瑟夫·沃特尔（Joseph Votel）去年曾表示，5月份对加沙地带发动袭击的以色列军队把AI整合到了行动中，这“对他们的命中周期产生的影响”令他感到震惊。他说，以色列正在使用AI来生成大量潜在目标，利用监视逐步缩小范围。这让其部队“无需漫长的准备期或更长的战役就可以破坏敌人的攻击。”

美国武装部队在Palantir（一家人工智能公司，与Anduril公司一样，公司名称都源自《指环王》）和其他承包商的帮助下，正试图将这类技术构建到一个系统中，可以压缩庞大的潜在目标群，并将相关信息顺畅地传递到最需要的地方。鉴于通信系统的容量有限（更不用说系统漏洞了），这需要在“边缘”（即承载传感器的平台上）完成越来越多的数据处理。

2016年，五角大楼的一个名为Maven的项目开始尝试解决瑞恩将军发现的“监视很多，结果很少”的问题。其想法是自动识别监视无人机发回的PB级视频片段中的人和物。它最终研发出了足够高效的软件，可以在无人机本身上运行。美国在最近一次以AI为重点的“猩红龙”演习中，使用了五花八门的系统来在大面积区域中排查小目标。它让卫星提供目标的估计位置，使用的是可被其他传感器或攻击系统读取的紧凑格式，而不是那种传输给人看的高清图片，这极大提高了速度。

在带宽往往是最大瓶颈的世界中，这种节约是一个福音。它让杀伤链大大提速，同时减少了数据阻塞的影响。同时，系统的自动化部分扛起了更大的责任，需要对自己看到的事物提供可靠的概要。这让一些人忧心忡忡，他们热衷于确保所有关于轰炸哪里、何时轰炸的决策都仍然是由完全知情又能负责的人员做出的。

| 重铸碎片

然而，尽管大量的边缘处理可能会减少个体设施的流量，有鉴于传感器可以大量“繁殖”，加之系统的其他环节也渴求更多信息，指挥系统仍将需要更大的容量来处理批量数据。这就是为什么武装部队正在大型科技公司提

供的云计算服务上投入巨资以提高自身的数据处理能力。2019年，五角大楼授予微软一份价值100亿美元的合同，用于其联合企业防御基础设施（JEDI）。去年，自2013年以来一直为中央情报局提供此类服务的亚马逊被取消了合同。11月发布的新招标可能会把这项工作分给一批公司，蛋糕会有足够大。

云在速度、规模和灵活性方面具有优势。它们还有助于“数据融合”——将不同的信息结合起来，揭示单个来源无法捕捉到的东西，包括人类想不到要去寻找的东西。“当你将来自不同来源的大量数据放在一起并对其运行AI算法时，它发现的规律会让你惊讶。”一位熟悉英国武装部队正在开发的Odyssey云计算系统的军官说。

融合不仅仅是把东西加起来；减法也很重要。在去年的一次演讲中，保罗·默里（Paul Murray）准将展示了北美防空司令部（NORAD）在2015年4月15日下午看到的一张雷达图像。它看起来就像是泼上了一桶蓝色颜料的画布。在这片混乱中的某处隐藏着道格·休斯（Doug Hughes）的飞行路线，他是佛罗里达州的一名邮递员，驾驶自己的直升机从葛底斯堡飞到国会大厦的草坪，向美国国会直接投递抗议信。无论这对立法机关产生了什么影响，他神不知鬼不觉穿越管制森严的空域的能力让NORAD十分惊恐。

休斯的做法并非完全未被发现。但它只被断断续续地捕捉到。而在一大堆其他信息同时出现时，当时查看数据的那名员工得出的结论是它完全无害。不过，当一个名为“寻路者”（Pathfinder）的系统融合了来自300多个传感器的相关数据并使用AI去除杂音后，这架不听话的飞机的路径就清晰可见了。

| 统治一切

“寻路者”的去杂音过程用到了商业飞行计划和天气报告来帮助清理；集成这样的开源数据对于许多情报和监视至关重要。去年，由谷歌前首席执行官埃里克·施密特担任主席的美国国家人工智能安全委员会表示，美国的情报机构需要将“源源不断的全源情报分析”构建成“持续学习的分析引

擎”，并希望结果将是“超越当前人类独立认知极限”的洞察力。它们称之为“用于侦察、情报和国家目标实现的全能神经网络工程”，简称ONERING。

科技公司的一些员工不喜欢参与此类事情。2017年，数千名谷歌员工签署了一封联名信，概述了他们对公司参与Maven项目的不满。微软对JEDI合同的竞标面临出于类似理由的内部反对声音。如此规模的数据融合也会让其他许多人担心，不管它是用于军事或任何其他目的。

至少在目前，他们可能会感到一些安慰，因为这种无缝连接单是想想或是投资都容易，实现起来却难得多。不同的军事部门和机构聘用不同的公司，按照自己想要的方式构建自己的云和AI系统，这很可能在上帝摧毁巴别塔之后再造出一个数字版本的巴别塔。军事组织习惯于提前多年把需求一丝不苟地列出，它们并不适应一个计算能力已成为订阅服务、新软件可以改变底层硬件的世界。

AI供应商Rebellion Defence的奥利弗·刘易斯（Oliver Lewis）表示，容易拿到整合数据任务的老派国防承包商“非常糟糕且毫无把握”。“他们经常使用为制造坦克和飞机而设计的工业时代方法，这使得他们无法编写出色的软件。”互通需要的商业和技术手腕往往在政府合同的管理中难得一见。“国防采购，”一位AI高管表示，“目前与这种新模式根本不兼容。”

问题还不仅仅是技术在变化、商业环境陌生、大规模系统集成总是很难——对于政府来说往往尤其如此。一个系统如果要融合和解释大量来自散落各处的不同来源的数据，那它不仅在日常运行时要十分稳健，在对手非常努力地破坏它们时也要屹立不倒。说起危机时刻，敌人也有发言权。■



Fierce contests

Deception and destruction can still blind the enemy

Many outcomes will still remain uncertain

THERE ARE four ways for those who would hide to fight back against those trying to find them: destruction, deafening, disappearance and deception. Technological approaches to all of those options will be used to counter the advantages that bringing more sensors to the battlespace offers. As with the sensors, what those technologies achieve will depend on the tactics used.

Destruction is straightforward: blow up the sensor. Missiles which home in on the emissions from radars are central to establishing air superiority; one of the benefits of stealth, be it that of an F-35 or a Harop drone, lies in getting close enough to do so reliably.

Radar has to reveal itself to work, though. Passive systems can be both trickier to sniff out and cheaper to replace. Theatre-level air-defence systems are not designed to spot small drones carrying high-resolution smartphone cameras, and would be an extraordinarily expensive way of blowing them up.

But the ease with which American drones wandered the skies above Iraq, Afghanistan and other post-9/11 war zones has left a mistaken impression about the survivability of UAVs. Most Western armies have not had to worry about things attacking them from the sky since the Korean war ended in 1953. Now that they do, they are investing in short-range air defences. Azerbaijan's success in Nagorno-Karabakh was in part down to the Armenians not being up to snuff in this regard. Armed forces without many drones—which is still most of them—will find their stocks quickly depleted if used against a seasoned, well-equipped force.

Stocks will surely increase if it becomes possible to field more drones for the same price. And low-tech drones which can be used as flying IEDs will make things harder when fighting irregular forces. But anti-drone options should get better too. Stephen Biddle of Columbia University argues that the trends making drones more capable will make anti-drone systems better, too. Such systems actually have an innate advantage, he suggests; they look up into the sky, in which it is hard to hide, while drones look down at the ground, where shelter and camouflage are more easily come by. And small motors cannot lift much by way of armour.

Moving from cheap sensors to the most expensive, satellites are both particularly valuable in terms of surveillance and communication and very vulnerable. America, China, India and Russia, all of which would rely on satellites during a war, have all tested ground-launched anti-satellite missiles in the past two decades; some probably also have the ability to kill one satellite with another. The degree to which they are ready to gouge out each other's eyes in the sky will be a crucial indicator of escalation should any of those countries start fighting each other. Destroying satellites used to detect missile launches could presage a pre-emptive nuclear strike—and for that very reason could bring one about.

| *Everybody has a plan until they get punched in the face*

Satellites are also vulnerable to sensory overload, as are all sensors. Laser weapons which blind humans are outlawed by international agreement but those that blind cameras are not; nor are microwave beams which fry electronics. America says that Russia tries to dazzle its orbiting surveillance systems with lasers on a regular basis.

The ability to jam, overload or otherwise deafen the other side's radar and radios is the province of electronic warfare (EW). It is a regular part of military life to probe your adversaries' EW capabilities when you get a chance. The deployment of American and Russian forces close to each

other in northern Syria provided just such an opportunity. “They are testing us every day,” General Raymond Thomas, then head of American special forces, complained in 2018, “knocking our communications down” and going so far as “disabling” America’s own EC-130 electronic-warfare planes.

In Green Dagger, an exercise held in California last October, an American Marine Corps regiment was tasked with seizing a town and two villages defended by an opposing force cobbled together from other American marines, British and Dutch commandos and Emirati special forces. It struggled to do so. When small teams of British commandos attacked the regiment’s rear areas, paralysing its advance, the marines were hard put to target them before they moved, says Jack Watling of the Royal United Services Institute, a think-tank in London. One reason was the commandos’ effective EW attacks on the marines’ command posts.

Just as what sees can be blinded and what hears, deafened, what tries to understand can be confused. Britain’s national cyber-strategy, published in December, explicitly says that one task of the country’s new National Cyber Force, a body staffed by spooks and soldiers, is to “disrupt online and communications systems”. Armies that once manoeuvred under air cover will now need to do so under “cyber-deception cover”, says Ed Stringer, a retired air marshal who led recent reforms in British military thinking. “There’s a point at which the screens of the opposition need to go a bit funny,” says Mr Stringer, “not so much that they immediately spot what you’re doing but enough to distract and confuse.” In time the lines between EW, cyber-offence and psychological operations seem set to blur.

The ability to degrade the other side’s sensors, interrupt its communications and mess with its head does not replace old-fashioned camouflage and newfangled stealth; they remain the bread and butter of a modern military. Tanks are covered in foliage; snipers wear ghillie suits. Warplanes use radiation-absorbent material and angled surfaces so as not

to reflect radio waves back to the radar that sent them. Russia has platoons dedicated to spraying the air with aerosols designed to block ultraviolet, infrared and radar waves. During their recent border stand-off, India and China both employed camouflage designed to confuse sensors with a broader spectral range than the human eye.

According to Mr Biddle, over the past 30 years “cover and concealment”, along with other tactics, have routinely allowed forces facing American precision weapons to avoid major casualties. He points to the examples of al-Qaeda at the Battle of Tora Bora in eastern Afghanistan in 2001 and Saddam Hussein’s Republican Guard in 2003, both of whom were overrun in close combat rather than through long-range strikes. Weapons get more lethal, he says, but their targets adapt.

Hiding is made easier by the fact that the seekers’ new capabilities, impressive as they may be, are constrained by the realities of budgets and logistics. Not everything armies want can be afforded; not everything they procure can be put into the field in a timely manner. In real operations, as opposed to PowerPoint presentations, sensor coverage is never unlimited.

“There is no way that we're going to be able to see everything, all of the time, everywhere,” says a British general. “It's just physically impossible. And therefore there will always be something that can happen without us seeing it.” In the Green Dagger exercise the attacking marine regiment lacked thermal-imaging equipment and did not have prompt access to satellite pictures. It was a handicap, but a realistic one. Rounding up commandos was not the regiment’s “main effort”, in military parlance. It might well not have been kitted out for it.

When hiding is hard, it helps to increase the number of things the enemy has to look at. “With modern sensors...it is really, really difficult to avoid being detected,” says Petter Bedoire, the chief technology officer for Saab, a

Swedish arms company. “So instead you need to saturate your adversaries’ sensors and their situational awareness.” A system looking at more things will make more mistakes. Stretch it far enough and it could even collapse, as poorly configured servers do when hackers mount “denial of service” attacks designed to overwhelm them with internet traffic.

Dividing your forces is a good way to increase the cognitive load. A lot of small groups are harder to track and target than a few big ones, as the commandos in Green Dagger knew. What is more, if you take shots at one group you reveal some of your shooters to the rest. The less valuable each individual target is, the bigger an issue that becomes.

Decoys up the ante. During the first Gulf war Saddam Hussein unleashed his arsenal of Scud missiles on Bahrain, Israel and Saudi Arabia. The coalition Scud hunters responsible for finding the small (on the scale of a vast desert) mobile missile launchers he was using seemed to have all the technology they might wish for: satellites that could spot the thermal-infrared signature of a rocket launch, aircraft bristling with radar and special forces spread over tens of thousands of square kilometres acting as spotters. Nevertheless an official study published two years later concluded that there was no “indisputable” proof that America had struck any launchers at all “as opposed to high-fidelity decoys”.

One of the advantages data fusion offers seekers is that it demands more of decoys; in surveillance aircraft electronic emissions, radar returns and optical images can now be displayed on a single screen, highlighting any discrepancies between an object’s visual appearance and its electronic signature. But decoy-making has not stood still. Iraq’s fake Scuds looked like the real thing to UN observers just 25 metres away; verisimilitude has improved “immensely” since then, particularly in the past decade, says Steen Bisgaard, the founder of GaardTech, an Australian company which builds replica vehicles to serve as both practice targets and decoys.

Mr Bisgaard says he can sell you a very convincing mobile simulacrum of a British Challenger II tank, one with a turret and guns that move, the heat signature of a massive diesel engine and a radio transmitter that works at military wavelengths, all for less than a 20th of the £5m a real tank would set you back. Shipped in a flat pack it can be assembled in an hour or so.

Seeing a tank suddenly appear somewhere, rather than driving there, would be something of a giveaway. But manoeuvre can become part of the mimicry. Rémy Hemez, a French army officer, imagines a future where armies deploy large “robotic decoy formations using AI to move along and create a diversion”. Simulating a build up like the one which Russia has emplaced on Ukraine’s border is still beyond anyone’s capabilities. But decoys and deception—in which Russia’s warriors are well versed—can be used to confuse.

Disappearance and deception often have synergy. Stealth technologies do not need to make an aircraft completely invisible. Just making its radar cross-section small enough that a cheap little decoy can mimic it is a real advantage. The same applies, *mutatis mutandis*, to submarines. If you build lots of intercontinental-ballistic-missile silos but put ICBMs into only a few—a tactic China may be exploring—an enemy will have to use hundreds of its missiles to be sure of getting a dozen or so of yours.

Shooting at decoys is not just a waste of material. It also reveals where your shooters are. Silent Impact, a 155mm artillery shell produced by SRC, an American firm, can transmit electronic signals as if it were a radar or a weapons platform as it flies through the sky and settles to the ground under a parachute. Any enemy who takes the bait reveals the position of their guns.

The advent of AI should offer new ways of telling the real from the fake; but it could also offer new opportunities for deception. The things that make an

AI say “Tank!” may be quite different to what humans think of as tankiness, thus unmasking decoys that fool humans. At the same time the AI may ignore features which humans consider blindingly obvious. Benjamin Jensen of American University tells the story of marines training against a high-end sentry camera equipped with object-recognition software. The first marines, who tried to sneak up by crawling low, were quickly detected. Then one of them grabbed a piece of tree bark, placed it in front of his face and walked right up to the camera unmolested. The system saw nothing out of the ordinary about an ambulatory plant.

The problem is that AIs, and their masters, learn. In time they will rumble such hacks. Basing a subsequent all-out assault on Birnam Wood tactics would be to risk massacre. “You can always beat the algorithm once by radical improvisation,” says Mr Jensen. “But it's hard to know when that will happen.”

| *The advantages of staying put*

Similar uncertainties will apply more widely. Everyone knows that sensors and autonomous platforms can get cheaper and cheaper, that computing at the edge can reduce strain on the capacity of data systems, and that all this can make kill chains shorter. But the rate of progress—both your progress, and your adversaries’—is hard to gauge. Who has the advantage will often not be known until the forces contest the battlespace.

The unpredictability extends beyond who will win particular fights. It spreads out to the way in which fighting will best be done. Over the past century military thinking has contrasted attrition, which wears down the opponent’s resources in a frontal slugfest, and manoeuvre, which seeks to use fast moving forces to disrupt an enemy’s decision-making, logistics and cohesion. Manoeuvre offers the possibility of victory without the wholesale destruction of the enemies’ forces, and in the West it has come to hold the upper hand, with attrition often seen as a throwback to a more

primitive age.

That is a mistake, argues Franz-Stefan Gady of the International Institute for Strategic Studies, a think-tank. Surviving in an increasingly transparent battlespace may well be possible. But it will take effort. Both attackers who want to take ground and defenders who wish to hold it will need to build “complex multiple defensive layers” around their positions, including air defences, electronic countermeasures and sensors of their own. Movement will still be necessary—but it will be dispersed. Consolidated manoeuvres big and sweeping enough to generate “shock and awe” will be slowed down by unwieldy aerial electromagnetic umbrellas and advertise themselves in advance, thereby producing juicy targets.

The message of Azerbaijan’s victory is not that blitzkrieg has been reborn and “the drone will always get through”. It is that preparation and appropriate tactics matter as much as ever, and you need to know what to prepare against. The new technologies of hide and seek will sometimes—if Mr Gady is right, often—favour the defence. A revolution in sensors, data and decision-making built to make targeting easier and kill chains quicker may yet result in a form of warfare that is slower, harder and messier. ■



激烈的较量

欺骗和破坏仍然可以蒙蔽敌人

许多结果仍不确定【专题《国防技术》系列之四】

隐藏起来的人有四种方法可以反击那些试图找到他们的人：破坏、致聋、消失和欺骗。针对所有这些选择的技术方法都会得到使用，以抵消将更多传感器带入作战空间带来的优势。与传感器一样，这些技术能实现什么取决于使用的策略。

破坏很简单：炸毁传感器。以雷达发射波为目标的导弹对于建立空中优势至关重要；无论是F-35还是哈洛普无人机，隐身的好处之一都在于足够靠近以一击命中。

但这需要雷达先暴露自己。而被动的系统可能难以被察觉，更换起来也更便宜。战区级别的防空系统并非设计用来发现携带高分辨率智能手机摄像头的小型无人机，用来打击这些东西成本过高。

但是，美国无人机在伊拉克、阿富汗和其他9/11后战区上空轻松游荡，让人对无人机的生存能力产生了错误的印象。自1953年朝鲜战争结束以来，大多数西方军队都不必担心会有什么东西从天而降攻击自己。现在既然需要担心了，他们就开始投资建设短程防空系统。阿塞拜疆在纳戈尔诺-卡拉巴赫取得成功的一部分原因是亚美尼亚人在这方面有所欠缺。没有很多无人机的武装部队（仍然占大多数）若与一支经验丰富、装备精良的部队作战，将会发现自己的储备很快枯竭。

如果能以相同的价格部署更多无人机，储备肯定会增加。低技术无人机可充当会飞的简易爆炸装置，在与非正规部队作战时会给对方造成麻烦。但“反无人机”的选择也应变得更强大。哥伦比亚大学的斯蒂芬·比德尔（Stephen Biddle）认为，使无人机功能更强大的趋势，也将使反无人机系统愈发进步。他指出，这样的系统实际上具有先天优势。它们仰望难以藏身的天空，而无人机则俯视更容易找到掩体和伪装的地面。此外小型电

机也无法携带太多能够当作装甲的东西升空。

说完便宜的传感器，来看看卫星这种最昂贵的传感器。卫星在监视和通信方面都特别有价值，但也非常脆弱。美国、中国、印度和俄罗斯在战争中都会依赖卫星，在过去的二十年里都已测试了从地面发射的反卫星导弹；有些国家可能也有能力用一颗卫星摧毁另一颗卫星。如果这些国家之间有任何争斗，它们准备把对方的空中之眼剜到什么程度将是战争升级的关键指标。摧毁用于探测导弹发射的卫星可能预示着一场先发制人的核打击——也因此可能会引发一场核打击。

| *每个人都有个计划，直到被打脸*

和所有传感器一样，卫星也会因感官过载而受损。国际协议禁止致人失明的激光武器，但并没有禁止会“弄瞎”摄像头的武器；能烧毁电子产品的微波束也没被禁止。美国称俄罗斯定期尝试用强激光照射美方的星轨监视系统。

干扰、过载或以其他方式使对方的雷达和无线电失聪的能力是电子战（EW）的范畴。伺机探查对手的电子战能力是军事生活的日常。美国和俄罗斯军队在叙利亚北部靠近彼此的部署就提供了这样一个机会。“他们每天都在考验我们，”时任美国特种部队负责人的雷蒙德·托马斯（Raymond Thomas）将军在2018年抱怨道，“破坏了我们的通信”，甚至“瘫痪”了美国自己的EC-130电子战飞机。

在去年10月于加州举行的“绿色匕首”演习中，美国海军陆战队的一个团的任务是夺取由其他美国海军陆战队、英国和荷兰突击队，以及阿联酋特种部队拼凑而成的敌对部队保卫的一个城镇和两个村庄，结果久攻不克。伦敦智库皇家联合军种研究所（Royal United Services Institute）的杰克·沃特林（Jack Watling）说，英国突击队的小分队袭击该团的后方，使其无法前进。该团很难在突击队行动之前就发现他们，原因之一是突击队对它的指挥站实施了有效的电子战攻击。

正如能见者可失明，能听者可失聪，能思者也可被迷惑。英国在12月发布

的国家网络战略明确表示，该国新成立的国家网络部队（由特工和士兵组成的机构）的一项任务是“破坏在线和通信系统”。曾领导英国军事思想改革的退休空军元帅埃德·斯金格（Ed Stringer）说，曾经在空掩护下行动的军队现在需要在“网络欺骗的掩护”下行动了。“在某个时候，对方的屏幕需要变得有点怪异，”斯金格说，“不至于让他们立即发现你在做什么，但足以分散注意力和混淆视听。”电子战、网络攻击和心理战之间的界限似乎早晚会变得模糊。

降低对方传感器的能力、中断其通信和打乱其思考的能力并不能取代老式的伪装和新奇的隐身方法，后者仍然是现代军队的基本生存之道。坦克被树叶覆盖；狙击手穿着吉利服。战机使用吸收辐射的材料和倾斜的表面，以免将无线电波反射回发射电波的雷达。俄罗斯有专门的部队来在空中喷洒气溶胶，以阻挡紫外线、红外线和雷达波。在近年的边境对峙中，印度和中国都使用了伪装，旨在混淆光谱范围比人眼更广的传感器。

根据比德尔的说法，在过去三十年中，“掩护和隐蔽”以及其他战术经常能让面对美国精确武器的部队避免重大伤亡。他指出了2001年阿富汗东部托拉博拉战役中的基地组织和2003年萨达姆侯赛因的共和国卫队的例子，他们都是在近距离战斗而不是远程打击中被击败。他说，武器变得更加致命，但目标会适应。

搜寻方的新能力尽管可能令人印象深刻，却受到预算和后勤等现实条件的限制，这让隐藏变得容易了些。不是军队想要的一切都能负担得起，军队采购的东西也不是全都能及时投入战场。实际战斗可不是幻灯片，传感器的覆盖范围永远都不会是无限的。

“我们不可能随时随地看到一切，”一位英国将军说。“这在物理上就是不可能的。因此，在我们没有看到的情况下，总会有一些事情发生。”在“绿色匕首”演习中，进攻的海军陆战团缺乏热成像设备，也无法及时获取卫星图片。这是一个不利条件，但很符合现实。用军事术语来说，围捕突击队并不是该团的“主攻方向”。它很可能没有准备好做这件事。

当隐藏很困难时，迫使敌人看更多的东西会有帮助。“有了现代传感器……真的很难避免被发现，”瑞典军火公司萨博（Saab）的首席技术官佩特·贝多尔（Petter Bedoire）说，“因此，你需要使对手的传感器和他们的局势感知力饱和。”盯着更多东西的系统会犯更多错误。如果给它足够大的压力，它甚至可能会崩溃，就像配置不当的服务器受到“拒绝服务”攻击时发生的那样——黑客的这类攻击旨在用互联网流量把它们冲垮。

分散力量是增加认知负荷的好方法。“绿色匕首”中的突击队员知道，许多小分队比少数大部队更难追踪和打击。更重要的是，如果你向一个小分队射击，你就会向其他人透露一些射手的位置。每个单个目标的价值越低，问题就越大。

诱饵让赌注愈发加码。在第一次海湾战争期间，萨达姆·侯赛因向巴林、以色列和沙特阿拉伯倾泻了他的飞毛腿导弹库。负责寻找他使用的小型（与广阔的沙漠相比）移动导弹发射器的联盟飞毛腿猎手似乎拥有梦想中所有的技术：可以发现火箭发射时的热红外信号的卫星、装满了雷达的飞机，遍布数万平方公里、充当侦察员的特种部队。尽管如此，两年后发表的一项官方研究得出的结论是，没有“无可争辩的”证据表明美国“击中了任何发射器，而不是高保真诱饵”。

数据融合为搜寻方提供的优势之一，是它对诱饵提出了更高的要求。在侦察机上，电子发射、雷达回波和光学图像现在都可以显示在同一个屏幕上，并突出显示物体的视觉外观与其电子特征之间的任何差异。但诱饵制造也没有停滞不前。在区区25米开外，伊拉克的假飞毛腿在联合国观察员看来就像真的一样。而自那以后，逼真度已经“极大”提高了，特别是在过去十年中，澳大利亚公司GaardTech的创始人斯汀·比斯加德（Steen Bisgaard）说。该公司制造假车辆作为练习目标和诱饵。

比斯加德说他可以卖给你一辆伪造的、非常逼真的便携式英国挑战者II坦克，它带有一个炮塔和能动的机枪，庞大柴油发动机的热量特征和一个在军用波长下工作的无线电发射器，所有这些加起来的花费还不到一辆真正的坦克500万英镑售价的20分之一。它装在扁平包装中，大约一个小时就

可以组装好。

看到坦克突然出现在某个地方，而不是开到那里的，在某种程度上会泄露天机。但是机动也可以成为模仿的一部分。法国军官雷米·赫梅兹（Rémy Hemez）想象未来军队部署大型“机器人诱饵编队，使用人工智能移动并转移对方视线”。模拟像俄罗斯在乌克兰边境部署的那种集结仍然超出了任何人的能力。但是诱饵和欺骗——俄罗斯的战士十分精通此道——可以用来混淆视听。

消失和欺骗往往具有协同作用。隐形技术不需要让飞机完全隐形。只要让它的雷达横截面足够小，用一个便宜的小诱饵就可以模仿它，那就是一个真正的优势。这同样适用于潜艇。如果你建造了许多洲际弹道导弹发射井，但只将洲际弹道导弹放入其中几个——中国可能正在探索这种策略——敌人将不得不使用数百枚导弹才能确保打掉十几枚你的导弹。

向诱饵射击不仅仅是浪费材料。它还透露了你的射手在哪里。由美国SRC公司生产的155毫米炮弹“静默冲击”（Silent Impact）会飞过天空并用降落伞下落到地面上，它可以像雷达或武器平台一样传输电子信号。任何上钩的敌人都会暴露炮火的位置。

AI的出现应该会提供辨别真假的新方法，但它也可能为欺骗提供新的机会。让AI喊出“有坦克！”的东西可能与人类认为像坦克的东西完全不同，从而揭穿愚弄人类的诱饵。但同时，AI也可能会忽略人类看来再清楚不过的特征。美国大学的本杰明·简森（Benjamin Jensen）讲述了海军陆战队接受训练来对抗配备物体识别软件的高端哨兵相机的故事。第一批试图匍匐通过的海军陆战队员很快就被发现了。然后其中一个人抓起一块树皮盖在脸上，径直走到镜头前，却没有引发丝毫反应。该系统不觉得一株会走路的植物有什么异常。

问题是AI和他们的主人会学习。久而久之，他们会发现这样的漏洞。基于《麦克白》中的勃南森林战术开展后续的全面攻击有可能全军覆没。“你总能用激进的即兴发挥击败算法一回，”简森说，“但很难知道这何时发

生。”

| 原地不动的优势

在更多的环节也会看到类似的不确定性。每个人都知道传感器和自主平台可以变得越来越便宜，边缘计算可以减少数据系统容量的压力，所有这些都可以通过缩短杀伤链。但是进步的速度——无论是你的进步，还是你的对手的进步——都很难衡量。在部队在作战空间里开打之前，通常都不会知道谁具有优势。

不可预测性将不仅存在于谁将赢得特定战斗，还存在于什么是最适合的作战方式。在过去的一个世纪里，军事思想对比了消耗战（在正面的战斗中消耗对手的资源）和机动战（试图使用快速机动的部队来破坏敌人的决策、后勤和凝聚力）。机动提供了在不彻底摧毁敌人的情况下取得胜利的可能性，并且在西方它已经占据上风，而消耗战通常被视为向更原始时代的倒退。

这是一个错误，智库国际战略研究所（International Institute for Strategic Studies）的弗朗茨-斯特凡·加迪（Franz-Stefan Gady）说。在日益透明的作战空间里生存下来依然是很可能的，但并不容易。想要占领地面的攻击方和想要守住它的防御方都需要在阵地周围建立“复杂的多重防线”，包括防空、电子对抗和自己的传感器。机动仍然是必要的——但它会被分散。大到足以产生“震慑”的那种集中式机动将被笨重的空中电磁伞拖慢脚步，并提前暴露自己，从而产生任人宰割的目标。

阿塞拜疆的胜利所传达的信息并不是闪电战已经重生和“无人机总能穿过去”，而是做准备和适当的战略同以往一样重要，而且你得知道要准备对付什么。捉迷藏的新技术有时——如果加迪是对的则是通常——有利于防御。传感器、数据和决策的革命旨在使发现目标更容易、杀伤链更快速，却可能会带来一种更慢、更难、更混乱的战争形式。 ■



To the victors, the scraps

Disney, Netflix, Apple: is anyone winning the streaming wars?

Investors are terrified that the prize may not be worth it

A TEENAGED GIRL who periodically transforms into a giant panda is the improbable star of “Turning Red”, a coming-of-age movie from Disney due out next month. The world’s biggest media company, which will celebrate its 100th birthday next year, is no adolescent. But Disney is going through some awkward changes of its own as it reorganises its business—worth \$260bn—around the barely two-year-old venture of video-streaming.

So far the experiment has been a success. Its streaming operation, Disney+, initially aimed for at least 60m subscribers in its first five years, ending in 2024. It got there in less than 12 months, and now hopes for as many as 260m subscribers by that date. Bob Chapek, who took over as boss just before the pandemic, is convinced that Disney’s future lies in streaming directly to consumers, his “north star”. On February 9th the company reported that Disney+ had added a healthy 11.8m subscribers in the latest quarter, shoring up its position as one of the most likely survivors of the ruthless contest that has become known as the streaming wars.

But doubts are surfacing across the industry about how much of a prize awaits the victors. Every year Disney and its rivals promise to spend more on content. And yet even as costs rise, the growth in subscribers is showing signs of slowing. A realisation is setting in that old media companies are pivoting from a highly profitable cable-television business to a distinctly less rewarding alternative.

Markets took fright last month when Netflix, the leading streamer, forecast that in the first quarter of 2022 it would add just 2.5m new members. That would be the weakest first quarter since 2010, when most Netflix

subscribers still got DVDs by mail. Its share price fell by more than a quarter on the news. Disney shares rallied earlier this month following its earnings report, which soundly beat expectations. Yet in the previous quarter Disney+ had added only 2.1m members, the least in its short existence. With some exceptions, streamers' breakneck growth seems to be slowing.

The firms blame temporary headwinds: a covid hangover, content delays and, in the case of Apple TV+, the phasing out of free trials. But some analysts are concluding that the ceiling for subscriptions is lower than they had thought. Morgan Stanley reckons Netflix will end 2024 with 260m global members, down from the investment bank's earlier estimate of 300m. And though streamers see the potential to raise prices in rich-world markets, that will be harder in the faster-growing poor ones. In India, Netflix recently cut the price of its basic plan from \$6.60 to \$2.60 a month. Morgan Stanley now expects Netflix's total revenue to grow by about 10% a year in the medium term, not the 15% or more it had previously predicted.

As revenue growth slows, costs swell. Media firms will spend more than \$230bn on video content this year, nearly double the figure a decade ago, forecasts Ampere Analysis, a research firm. Netflix's weak results came despite what it billed as its "strongest content slate ever", including "Squid Game", its most popular series, and "Don't Look Up", whose shortlisting for Best Picture on February 8th contributed to Netflix's haul of 27 Oscar nominations, the most of any studio. Disney+ is doing far better than its parent ever dreamed—but it is costing more, too. Three years ago Disney said it would spend about \$2bn on streaming content in 2024. Mr Chapek recently said the figure would surpass \$9bn.

Spending is going up partly because costs of filming have risen. The final season of WarnerMedia's "Game of Thrones", in 2019, cost around \$15m an episode, which then seemed steep. Amazon's serialised "Lord of the Rings", due in September, reportedly cost four times as much. Audiences have

become more demanding. Most people used to cancel their cable-TV subscription only when they moved house, says Doug Shapiro, a former strategy chief at Turner Broadcasting System, a TV company. Now, he says, they are “becoming accustomed to churning on or off over the quality of content”, signing up to devour the latest hit then cancelling their membership. Apple TV+, which has the most serious retention problem, loses a tenth of its customers every month, according to Antenna, a data firm, meaning that every year it churns through the equivalent of more than 100% of its members (see chart).

The combination of rising costs and slowing revenue growth “calls into question the end-state economics of these businesses”, argues MoffettNathanson, a firm of analysts. Netflix, the most successful of the bunch, expects its operating margin to shrink in 2022, for the first time in at least six years, to 19%; the firm has attributed this to higher spending on programming. MoffettNathanson adds that these figures flatter the company’s performance. Like other streamers, Netflix amortises the cost of content over several years, when in reality most of its shows are binged in a matter of weeks. (The firm insists its amortisation schedule is based on viewing patterns.)

Streaming’s pinched economics are especially galling for old media companies such as Disney, which are used to the far more profitable cable-TV business. Last year Disney reported an operating margin of 30% for its linear TV networks, a typical figure for the industry. The average American cable bill is nearly \$100 a month—and viewers are usually subjected to advertising to boot. Media firms are accelerating the decline of this profitable business by shifting their best content from cable to their streaming services. They are also forgoing box-office revenue by sending movies straight to streaming (though covid-related cinema closures have often forced their hand). Animators at Disney’s Pixar studio are said to be miffed that “Turning Red” is not getting an outing at the cinema in most

countries.

There is little choice but to stick with the strategy. Cable is not coming back; streaming is expected to account for half of TV viewing in America by 2024. The focus is turning to how to make the new business more profitable. Streamers increasingly drip-feed new episodes rather than dropping entire series. Bundling is becoming more common: Disney sells Disney+ along with ESPN+, its sports streamer, and Hulu, a general entertainment service that it jointly owns with Comcast, a cable giant. Apple and Amazon both package TV with other services. WarnerMedia and Discovery plan to merge; regulators have waved the deal through, the companies said on February 9th. There may be more to come. "If Netflix is decelerating more rapidly than expected, the great streaming rebundling may need to begin sooner rather than later," writes Benjamin Swinburne of Morgan Stanley.

The hope at the big media firms is that the streaming wars will eventually claim some casualties, leaving the survivors free to raise prices and dial down spending on content. Peacock, Comcast's streamer, is trailing. Viacom CBS, which owns Paramount+, is the subject of endless takeover rumours. But even their exit would leave some determined rivals. Warner-Discovery is betting its future on streaming. Apple and Amazon are getting better at making hits, and have enough money to run at a loss for as long as they like. Disney and Netflix aren't going anywhere. It looks like being a long war, short on spoils. ■



杀出血路，捡些零碎

迪士尼、奈飞、苹果：有谁在赢得流媒体大战吗？

投资者很惊慌，怕战利品根本不值

迪士尼的青春成长片《青春变形记》（Turning Red）将于下月上映，影片的主角居然是一个不时会变身成一只硕大的熊猫的少女。而这家世界上最大的媒体公司明年就要庆祝100岁的生日，自己早已不复青葱。但它正在围绕成立不过两年的视频流媒体项目重组价值2600亿美元的业务，过程中也在经历一些尴尬的变化。

到目前为止这项尝试是成功的。它的流媒体业务Disney+最初的目标是到2024年也就是成立的第五个年头拿下至少6000万名用户。结果不到12个月就达成了目标，现在它希望到那时用户数将达到2.6亿。在疫情前刚刚接任老板的鲍勃·查佩克（Bob Chapek）坚信迪士尼的未来在于直接向消费者推送流媒体内容——这就是指引他的“北极星”。2月9日，迪士尼报告称，最近一个季度Disney+用户数增加了可观的1180万人，这进一步巩固了迪士尼的阵脚——目前它是最有可能在流媒体大战这场残酷竞争中存活下来的公司之一。

但是，整个行业都开始怀疑胜出者能有多大斩获。迪士尼及其竞争对手每年都承诺增加内容上的投入。然而成本上升之时，订户增长也显示出放缓的迹象。人们渐渐意识到，老牌媒体公司正从利润丰厚的有线电视业务转向一个回报明显更低的业务。

流媒体平台翘楚奈飞（Netflix）上月预测2022年第一季度它将只增加250万新会员，令市场大受惊吓。这将是它自2010年以来最疲软的第一季度，而在那一年大多数奈飞用户还在通过邮件租借DVD。消息传出后，奈飞股价下跌超过四分之一。迪士尼在本月上旬发布了显著超出预期的财报后股价回升。然而在上一个季度，Disney+仅增加了210万名会员，是其不长的历史中最少的一次。除了个别例外，各家流媒体平台的迅猛增长似乎都慢了下来。

对此这些公司归咎于一些暂时性的不利因素：新冠的后遗症、新内容延迟上架；在Apple TV+这个案例中还有用户逐渐享受完免费试看期的因素。但一些分析师得出结论称，订阅用户数的顶峰比他们之前想象的要低。摩根士丹利估计奈飞到2024年底将在全球拥有2.6亿会员，低于该投行此前估计的3亿。而尽管流媒体平台认为在富裕国家市场有提价的潜力，但想要在增长更快的穷国提价就难了。在印度，奈飞最近将基本套餐的价格从每月6.60美元下调至2.60美元。摩根士丹利现在预计奈飞中期内总收入将每年增长10%左右，而不是之前预测的15%或更高。

收入增长放缓之际，成本却在膨胀。研究公司安培分析（Ampere Analysis）预测，今年媒体公司在视频内容上的支出将超过2300亿美元，将近十年前的两倍。奈飞发布了乏善可陈的业绩，尽管它推出了号称“史上最强内容阵容”，包括它最受欢迎的剧集《鱿鱼游戏》和2月8日入围奥斯卡最佳影片的《不要抬头》（至此奈飞获得的奥斯卡提名达到27个，比任何电影公司都多）。Disney+的表现远超其母公司想象——但它的成本也超过预期。三年前，迪士尼表示2024年将在流媒体内容上投入约20亿美元。而查皮克最近表示，这一数字将超过90亿美元。

支出增加的部分原因是拍摄成本上升。2019年，华纳媒体（WarnerMedia）的《权力的游戏》最终季每集的成本约为1500万美元，在当时看起来很高；而亚马逊定于9月推出的剧集《指环王》的成本据称是它的四倍。观众的要求越来越高。电视公司特纳广播系统（Turner Broadcasting System）的前战略主管道格·夏皮罗（Doug Shapiro）说，以前，大多数人只有在搬家时才会取消有线电视订阅。而现在，他说，人们“已经习惯了看内容的质量好坏来决定订阅或是退订”，他们在有大热新剧时才注册，一口气看完后就解除会员。数据公司Antenna的数字显示，Apple TV+的用户留存问题最严重，每月流失十分之一的客户，相当于每年的用户全部换一轮还不止（见图表）。

分析公司莫菲特内桑森（MoffettNathanson）认为，成本上升叠加收入增长放缓“让人质疑这些业务最终的经济效益”。它们当中最成功的奈飞预计2022年自己的营业利润率将收缩至19%，为至少六年来首次。该公司将此

归因于节目支出增加。莫菲特内桑森补充说，这些数字已经美化了奈飞的业绩。像其他流媒体平台一样，奈飞将内容成本分摊在几年的时间里，而实际上它大部分的剧观众都是在几星期内一口气刷完的。（奈飞坚称其分摊时间表是基于收看模式。）

流媒体寡淡的财务表现尤其令迪士尼等老牌媒体公司懊恼，它们已习惯了利润高得多的有线电视业务。去年，迪士尼报告其线性电视网络的运营利润率为30%，在行业里是很平常的数字。美国有线电视平均每月收费接近100美元，而且观众通常不得不看开机广告。媒体公司把它们最好的内容从有线电视转移到自己的流媒体平台上，正在加快有线电视这一利润丰厚的业务的衰落。它们还直接将电影放到流媒体上播放，放弃了票房收入（尽管通常都是由于新冠肺炎造成影院关闭，它们别无他法）。《青春变形记》在大多数国家都不会登陆院线，据说迪士尼皮克斯工作室的动画师们为此不大高兴。

除了坚持原战略，几乎别无选择。有线电视回不来了：预计到2024年，流媒体播放将占美国电视观看量的一半。重点正在转向如何让这个新业务更有利可图。流媒体平台越来越多地将节目一点一点地放出，而不是一股脑抛出整部剧。捆绑销售越发常见：迪士尼提供Disney+与其体育流媒体服务ESPN+以及Hulu（迪士尼跟有线电视巨头康卡斯特共同拥有的综合娱乐服务）的三合一订阅服务。苹果和亚马逊都将电视与其他服务打包销售。华纳媒体和Discovery计划合并，两家公司2月9日表示，监管机构已经批准了这笔交易。以后可能还会有更多抱团的举动。摩根士丹利的本杰明·斯威本（Benjamin Swinburne）写道，“如果奈飞的减速比预期快，那么大规模的流媒体再捆绑可能就需要尽早开始。”

大型媒体公司抱持的希望是，流媒体大战最终会造成一些伤亡，让幸存者得以自由地提价，并减少内容支出。康卡斯特的流媒体服务Peacock逐渐掉队。拥有Paramount+的维亚康姆哥伦比亚广播公司（Viacom CBS）成日被传要被谁收购。但即使它们退出争战，也会有一些对手坚决不撤退。华纳和Discovery合并后的公司将未来押在流媒体上。苹果和亚马逊越来越擅长制造爆款，而且它们不缺钱，亏多久都不在意。迪斯尼和奈飞也不

会放弃阵地。看起来这会是一场持久战，战利品却寥寥无几。■



The Economist Film

The true costs of ageing - trailer

The wealthy world is ageing, fast. And it's storing up a big problem.



经济学人视频

老龄化的真实代价 - 预告

富裕国家正在迅速变老。这将在未来造成巨大的问题。



Free exchange

A new history of sanctions has unsettling lessons for today

Sometimes they create the problem they are trying to solve

JUST AFTER the end of the first world war and the dissolution of Austria-Hungary, one observer noted that “every clock in Prague [was] gone, melted for the metals.” Another, in Vienna, saw children “wrapped in paper, for want of sheets and blankets”. At the time much of Europe was under strict economic sanctions, as western powers tried to hold the post-war peace and restrain communism. It was the first time that the “economic weapon”, the title of Nicholas Mulder’s new book, had been used, but by no means the last. By the 2010s a third of the world’s population lived under sanctions. Prominent among the current targets is Russia, which faces further sanctions over its invasion of Ukraine. Mr Mulder, of Cornell University, looks at sanctions over the three decades after the first world war—and reaches unsettling conclusions.

Economic war against civilians is a centuries-old phenomenon. During the Hundred Years’ War English troops launched countless brutal sieges against French garrisons, often starving them into submission. Blockades were an important part of the toolkit of the naval wars of the 18th century. Sanctions were and are different. Rather than being imposed by one country on another, they often involved groups of countries coming together to punish rogue states. The formation of the League of Nations in 1919-20 made co-ordinated action easier. And rather than being seen as an act of war, sanctions were often supposed to prevent it.

Sanctions were also the product of the first great wave of globalisation. In the 70 years to 1914 trade flows rose from 5% of global GDP to 14%, then an all-time high. With economies ever more integrated, like-minded governments had many points of leverage over renegades, whether by

denying them the supply of crucial raw materials or by refusing to buy their goods.

The role of finance truly distinguished sanctions from previous economic warfare. In 1870-1914 annual capital flows averaged 4% of global GDP. The Allied powers controlled the world's main financial centres. Economists, as well as traditional military types, thus helped design sanctions. They aimed to hit aggressor states where they were weakest: in their financing requirements.

Mr Mulder's book is filled with anecdotes of how sanctions worked in practice. As signs of impending war grew in 1935, Italian companies such as Pirelli (tyres), Fiat (cars) and Montecatini (chemicals) were denied financing for their import needs by the Bank of England. By August 1941 expansionist Japan was cut off from the rest of the world economy, having lost 90% of its foreign oil supply and 70% of its trade revenues. Enforcing sanctions required a great deal of effort in a world of increasing financial ingenuity. In the late 1910s Banco Holandés de la América del Sud, a Buenos Aires subsidiary of a Dutch bank, used five different names to undertake transactions for various Latin American subsidiaries of German banks.

William Arnold-Forster, a British administrator, argued that sanctions could "make our enemies unwilling that their children should be born". Indeed, they could have horrific effects. Of the three main weapons targeting civilians during the period—air power, gas warfare and economic blockade—blockade was by far the deadliest, Mr Mulder argues. "Pens seem so much cleaner instruments than bayonets," Arnold-Forster wryly noted.

Whether sanctions achieved their objectives was another matter. Small countries could be bullied into obedience, such as on two occasions in the 1920s, when the threat of sanctions stopped skirmishes in the Balkans from escalating into wider war. Bigger powers were tougher nuts to crack.

Overall, “most economic sanctions have not worked”—the first lesson of Mr Mulder’s book. Most significantly, they did not stop Germany from choosing war.

Sanctions sometimes failed because of insufficient political will. For a long time American opinion had it that sanctions were fundamentally un-American, an anachronistic form of European-style imperialism. In other cases financial globalisation constrained, rather than widened, sanctioners’ room for manoeuvre. Britain refrained from imposing a severe financial blockade of Nazi Germany in the mid-1930s in part because British banks held huge amounts of German debt. In the event of sanctions the Reich would stop servicing this debt, and British financiers worried that the City would face a solvency crisis.

The second lesson of Mr Mulder’s book is that sanctions can have unintended consequences. By the 1930s global politics and economics had radically changed from the 1920s. The Great Depression had sent many governments down a protectionist route. Global trade was in a long slump. Fascism was on the march.

| *Doom loop*

Sanctions, Mr Mulder shows, added fuel to the fire. Governments that believed themselves vulnerable to sanctions withdrew even further from the global economy, in order to secure strategic independence. In the 1930s Japan sought to develop a “yen bloc”, an economic zone including Korea and Taiwan, so as to reduce dependence on the Allied powers. In the mid-1930s Germany gunned for “raw-materials freedom”, in part via the construction of massive capacity for the synthetic production of oil. (Anyone witnessing Russia’s efforts in recent years to wean itself off Western finance may conclude that nothing much has changed.) It also necessitated conquest. “I need Ukraine”, said Adolf Hitler in 1939, “so that they cannot again starve us out like in the last war.”

In that sense the international search for effective sanctions and the ultra-nationalist search for autarky “became locked in an escalatory spiral”. Sanctions did not work in a deglobalising world, and contributed to its continued fracturing, in turn setting the stage for the second world war. Mr Mulder is too careful a historian to labour the parallels between what happened in the inter-war period and today, when geopolitics is once again fractious and globalisation is in retreat. But the lessons are sobering. ■



自由交流

一部制裁新史给今天的警示

有时制裁制造了它们想要解决的问题

就在第一次世界大战结束和奥匈帝国解体之后，一位观察家指出“布拉格的每只钟都不见了，都被熔了炼金属”。另一位维也纳的观察家看到孩子们“用纸裹身，因为没有床单和毯子”。当时，西方大国试图维持战后和平，遏制共产主义，欧洲大部分地区都处于严苛的经济制裁之下。那是世界第一次使用这种“经济武器”——尼古拉斯·穆德（Nicholas Mulder）新书的名字——但绝不是最后一次。到了2010年代，全世界有三分之一的人口生活在制裁之下。目前最引人注目的制裁目标是俄罗斯，在入侵乌克兰后它面临进一步的制裁。在康奈尔大学任教的穆德回顾了一战后三十年里的制裁措施，得出了令人不安的结论。

对平民发起经济战的现象已存在数百年。百年战争期间，英国军队对法国卫戍部队发动了无数次残酷的围攻，经常让他们因饥饿而投降。封锁是18世纪海战的一个重要战术。制裁不是同一回事——无论在过去还是现在。制裁通常不是由一个国家对另一个国家实施，而是一群国家联手惩罚流氓国家。1919年至1920年国际联盟的成立让协调行动更易开展。人们通常认为制裁不是一种战争行为，而是为了阻止战争。

制裁也是第一次全球化大潮的产物。在截至1914年的70年间，贸易流动从占全球GDP的5%上升到14%，在当时创下历史新高。随着各经济体日益一体化，志同道合的政府有很多筹码可以对付叛逆者：可以拒绝向它们提供关键的原材料，也可以拒绝购买它们的商品。

金融所发挥的作用真正将制裁与以往的经济战区分开来。1870年至1914年间，每年的资本流动平均占到全球GDP的4%。同盟国控制了全球主要的金融中心。于是，除了传统的军事家，经济学家也参与制定了制裁措施。他们的目标是打击侵略国最大的软肋：融资需求。

穆德的书中有许多关于制裁如何在实践中发挥作用的轶事。1935年，战争逼近的迹象日益明显，英格兰银行拒绝为倍耐力（轮胎）、菲亚特（汽车）和蒙特卡蒂尼（化工）这类意大利公司提供融资以满足其进口需求。到1941年8月，奉行扩张主义的日本已被斩断了与世界经济其他部分的联系，失去了90%的外国石油供应和70%的贸易收入。在一个金融手段越来越多的世界里，要实施制裁很费工夫。1910年代末，一家荷兰银行位于布宜诺斯艾利斯的分支机构荷兰南美银行（Banco Holandés de la América del Sud）曾用五个不同的名字为几家德国银行在拉丁美洲的多个分支执行交易。

在一战中参与策划海上封锁德军的英国海军官员威廉·阿诺德-福斯特（William Arnold-Forster）认为，制裁会“让我们的敌人宁愿自己的孩子没有出生”。确实，这些措施可能产生可怕的影响。穆德认为，在当时针对平民的三种主要武器之中——空袭、瓦斯战和经济封锁——封锁绝对是最致命的。“钢笔看起来比刺刀干净太多啦。”阿诺德-福斯特讽刺道。

制裁能否达到目的就是另一回事了。小国可能会被迫屈服，比如1920年代的两次制裁威胁阻止了巴尔干半岛的小规模冲突升级为更大范围的战争。大一些的国家就更难对付了。总的来说，“大多数经济制裁都没起到效果”——这是穆德书中的第一条教训。最能说明问题的就是，制裁并没能阻止德国发动战争。

制裁失败有时是因为政治意愿不足。在很长一段时间里，美国人认为制裁从根本上说是非美国式的，是欧洲式帝国主义的一种过时的做法。其他情况下，金融全球化限制了（而不是扩大了）制裁者的操作空间。1930年代中期，英国没有对纳粹德国实施严厉的金融封锁，部分原因是英国的银行持有大量德国债务。一旦受到制裁，德国会停止偿还这些债务，英国金融家担心伦敦金融城将面临偿债能力危机。

穆德书中的第二个教训是，制裁可能会产生意想不到的后果。到了1930年代，全球政治和经济形势已与1920年代有根本性的不同。大萧条让许多政府走上了保护主义的道路。全球贸易长期低迷。法西斯主义不断扩散。

| 厄运循环

穆德向读者展示，制裁是火上浇油。认为自己易受制裁影响的政府会进一步退出全球经济，以确保战略独立。1930年代，日本曾谋求建立一个“日元圈”，即一个包括朝鲜半岛和台湾在内的经济区，以减少对同盟国的依赖。1930年代中期，德国竭力寻求“原材料自由”，在一定程度上是依靠大规模建设合成燃料生产能力。（目睹俄罗斯近年来努力摆脱对西方金融的依赖的人可能都会得出结论：事情从来都没多大变化。）它也使征服成为需要。“我需要乌克兰，”希特勒在1939年说，“这样他们就不会再像上次战争中那样把我们饿死了。”

从这个意义上说，国际社会寻求有效制裁和极端民族主义者寻求自给自足“陷入了螺旋式上升的循环”。在一个去全球化的世界里，制裁没有起作用，而是加剧了世界的持续分裂，进而为第二次世界大战埋下伏笔。作为一名审慎的历史学家，穆德没有拿两次世界大战之间发生的事与今天的情况做类比——如今地缘政治再次变得剑拔弩张，全球化正在倒退。但他总结的教训发人深省。 ■



Schumpeter

How Sony can make a comeback in the console wars

It could be an Epic battle

FOR THE uninitiated, which includes your columnist, there are two things to know about video gaming. The first is that some things never change. For all the virtual worlds they can create, gamers, a mostly male bunch, like nothing better than to blow their on-screen opponents to smithereens. The second is that everything else is in flux. Gaming is moving from consoles, PCs and smartphones to streaming and the metaverse. It is not just avatars that are being shot to shreds. Business models are, too.

Bear both points in mind when making sense of recent deals involving the two biggest rivals in the console wars, Microsoft, maker of the Xbox, and Sony, producer of the PlayStation (Nintendo is in its own orbit). To cater to those itchy trigger-fingers, both want to expand their bestselling “first-person shooter” rosters. Microsoft’s \$69bn acquisition of Activision Blizzard, a publisher, would give the tech giant ownership of “Call of Duty”, one of the most successful shoot-’em-up franchises of all time. Sony’s \$3.6bn takeover of Bungie brings it “Destiny 2”, another popular shooter.

The large sums of money changing hands highlight the second point: that everything is up in the air, even the relative strength of each firm. For years Sony has had the advantage. Its latest consoles, PlayStations 4 and 5, have far outsold equivalent Xboxes. It has more exclusive games, which draw in fiercely loyal players. Yet Microsoft’s acquisition of Activision, if it fends off antitrust concerns, could alter the balance of power. According to Newzoo, a data-gatherer, it could put Microsoft’s game-software revenue ahead of Sony’s, even combined with Bungie. It underscores Microsoft’s commitment to a subscription and streaming service, funded by a mountain of cash and supported by its Azure cloud business. It reflects a

willingness to be open to a range of devices and business models, including free-to-play games and ad-supported ones. It could, literally, be a game-changer.

Like Netflix in video, Microsoft hankers after vast subscriber growth. That fits with the current zeitgeist that everything in business, from media to Microsoft's Office 365 programs, should be based on subscriptions, rather than one-time sales—and reliant on the cloud. But while it is tempting to think Sony should chase after Microsoft, it has neither the money to outspend it on content nor, despite a foray into streaming called PS Now, the infrastructure to compete with it in the cloud. The Bungie deal, which is big for Sony, makes the gap between the two companies' financial firepower starkly clear. Thomas Aouad of Drawbridge Research, an analysis firm, likens it to taking a spoon to a gunfight rather than a knife. To outmanoeuvre Microsoft, Sony must do something different—and uncharacteristically bold.

For starters, it could make the case that streaming and subscription services are no guaranteed road to riches. Yes, streaming dispenses with the need for a costly console, which could draw in casual gamers. But unlike Netflix viewers, players interact with streamed material, often at speeds measured in the milliseconds when their fingers are on the trigger. Low latency, or lag, over an internet connection is a life-and-death matter for a player's avatar.

The business model is unproven, too. Sony and Microsoft have long used consoles as loss-leaders to sell high-margin games to which they often hold exclusive rights (think Gillette razors and razor blades). The approach has benefited their overall gaming businesses, as well as independent game developers. In contrast, selling blockbuster content via monthly subscriptions involves vast outlays and fewer barriers to entry. It may attract lots of new users. Microsoft's Game Pass service, which grants access

to a library of games to run on consoles for up to \$14.99 a month, has 25m subscribers; Netflix is getting into games. But such services could face brutal competition and need constant replenishing with blockbuster titles to reduce customer churn. Indeed, Sony, with a deep catalogue of music and films, has profited from being the source of such replenishment for video- and music-streamers.

As an alternative gaming strategy, on February 2nd it outlined plans to double down on “live service” games such as “Destiny 2”, which are regularly upgraded and hence easy to monetise. That is not enough, though. It also needs to outline a strategy that draws on its efforts to break down the silos between its gaming, music, film, electronics and image-sensor businesses. As Kato Mio, who publishes on Smartkarma, an investment-research site, puts it, while other firms, such as Meta, talk of building the metaverse, Sony already has many of the ingredients for immersive entertainment (including virtual reality) at its fingertips. It needs to turn its conglomerate structure into a virtue.

That means cross-fertilising its entertainment business, by releasing games as films, for instance. More ambitiously, it should put its cutting-edge technologies in better service of the future of entertainment. Here, its small stake in Epic, a maker of hit games such as “Fortnite”, and gamemaking technology such as Unreal Engine, could be a building block. If Tencent, a Chinese tech giant, were ever minded to sell its 40% stake in Epic, Sony should consider raising its investment. With Epic as a partner, Sony could hold its own much better against Microsoft.

| *Mutually assured destruction*

In the near term, Sony needs a strong enough slate of content to retaliate if Microsoft tries to deprive the PlayStation of Activision titles (Microsoft says it won't). It has other problems to confront, such as a slowdown in PlayStation 5 sales due to the supply-chain crunch, and game developers'

demands that console-makers cut the commissions they charge. In the longer run, Sony's strength is that gaming, which accounts for over a quarter of its revenues, is crucial to its future. For Microsoft, it is less existential. That is an incentive to think big—and laterally. Sony has a panoply of entertainment and technology businesses to turn to, as well as a potential partner in Epic. To safeguard its future, it should do so. ■



熊彼特

索尼如何在主机大战中绝地反击

这可能是一场“史诗”级大战

对包括笔者在内的外行来说，关于电子游戏要了解两件事。首先是有些东西永远不会变。不管创造出什么样的虚拟世界，以男性为主的游戏玩家最喜欢的还是把屏幕上的对手打个稀巴烂。其次是其他一切都在变。游戏正在从游戏机、个人电脑和智能手机转向流媒体和元宇宙。被打个稀巴烂的不仅仅是游戏里的虚拟化身，还有商业模式。

主机大战中最大的两个对家最近各自有交易，要看明白这些交易就要记得上面这两点。这两家分别是制造Xbox的微软和生产PlayStation的索尼（任天堂走在自己的轨道上）。为了迎合那些手痒难耐的玩家，双方都想扩大它们最畅销的“第一人称射击游戏”阵容。微软宣布以690亿美元收购发行商动视暴雪（Activision Blizzard），这将让这家科技巨头拥有史上最成功的射击游戏系列之一《使命召唤》。索尼以36亿美元收购Bungie为它带来了另一款热门射击游戏《命运2》。

这些大手笔交易凸显了第二点——一切都悬而未决，甚至是各家公司的相对实力。多年来，索尼占据优势。它最新的游戏主机PlayStation4和PlayStation5的销量远远超过了对家产品Xbox。它的独家游戏更多，吸引了众多死忠玩家。然而，如果微软收购动视暴雪能够避过反垄断雷达，可能会改变双方实力的天平。根据数据收集公司Newzoo的说法，这笔交易可能会让微软的游戏软件收入超过索尼——即使在后者收购了Bungie之后。收购动视暴雪表明微软决意发展订阅和流媒体服务，它有充沛的现金来为这一块注资，又有Azure云业务的技术支持。这反映出微软乐于接受不同的设备和商业模式，包括免费游戏和内嵌广告的游戏。这真的有可能改变“游戏规则”。

就像视频领域的奈飞（Netflix）一样，微软也追求订阅用户大幅增长。这符合当前的时代趋势，也就是从媒体到微软的Office 365程序，所有业务都

应该采取订阅模式而不是一次性销售——并且依赖云。但是，尽管人们很容易会认为索尼应该追赶微软，但它既没那么多钱在内容支出上压过微软，也没有能与微软竞争的云基础设施（即便它推出了名为PS Now的流媒体服务）。收购Bungie对索尼来说是笔巨额交易，这让它和微软的财力差距一目了然。分析公司Drawbridge Research的托马斯·阿瓦德

（Thomas Aouad）打比方说，这都不是拿着刀去打枪战，而是拿了把勺子。要想比微软技高一筹，索尼必须剑走偏锋，而且是一反常态地大胆。

首先，它可以证明流媒体和订阅服务并不能保证带来财富。诚然，流媒体不需要使用昂贵的主机，可以吸引到随便玩玩的人。但与奈飞的观众不同，玩家要与流媒体的内容互动，当他们的的手指触动扳机时速度往往以毫秒计。低延迟的互联网连接对玩家的虚拟化身来说生死攸关。

订阅的商业模式也还未经验证。长期以来，索尼和微软一直靠亏本卖游戏机来销售高利润游戏，它们通常拥有这些游戏的专营权（想想吉列的剃须刀架和刀片）。它们的整个游戏业务和独立游戏开发商都从这种模式中获益。相比之下，以每月订阅模式销售大热内容需要大举砸钱，而进入的门槛更少。这可能会吸引到众多新用户。微软的Game Pass服务以每月最高14.99美元的收费开放一个可在主机上运行的游戏库，现在有2500万用户；奈飞正在进驻游戏领域。但这类服务可能面临残酷的竞争，需要不断补充重磅游戏以减少用户流失。事实上，拥有丰厚的音乐和电影库存的索尼就通过为视频和音乐流媒体平台补充内容来获利。

作为另一种游戏策略，索尼在2月2日宣布计划加倍投入《命运2》等“实时服务”（live service）游戏。这些游戏会定期升级，因此易于变现。但这还不够。它需要从自身经验中勾勒出一个战略蓝图，努力打破自家的游戏、音乐、电影、电子和图像传感器等业务之间的隔阂。正如在投资研究网站Smartkarma上发表文章的加藤敏夫所说，当Meta等其他公司在大谈构建元宇宙时，索尼手里已经有了许多沉浸式娱乐（包括虚拟现实）的要素。它需要把自己的企业集团结构转变为一种优势。

这意味着要交叉培育其娱乐业务，比如像发行电影那样发行游戏。更雄心

勃勃的做法是，索尼应该利用自己的尖端技术来更好地服务未来的娱乐。在这方面，它在Epic（《堡垒之夜》等热门游戏和虚幻引擎等游戏制作技术的开发商）的少量股份可以作为发展的基石。如果中国科技巨头腾讯有意出售其在Epic持有的40%的股份，索尼应该考虑增资。有了Epic作为合作伙伴，索尼可以大大提升对抗微软的能力。

| 确保相互摧毁

在短期内，如果微软试图让动视暴雪的游戏退出PlayStation平台（微软表示不会），索尼就需要足够强大的内容来反击。它还需要面对其他问题，例如由于供应链紧张导致PlayStation 5销售放缓，以及游戏开发商要求主机制造商降低收取的佣金。从长远来看，索尼的优势是占其收入四分之一以上的游戏业务对它的未来至关重要。对微软来说，游戏业务没有那么生死攸关。这就会激发索尼做远大思考，以及横向思考。它拥有一整套娱乐和技术业务可以利用，还有Epic这个潜在合作伙伴。为了保卫自己的未来，它应该这么做。■



Biotechnology

A \$3bn bet on finding the fountain of youth

Can an instant unicorn crack cellular rejuvenation?

STARTUPS COME and startups go. But few startups start with \$3bn in the bank. Yet that is the fortunate position in which Altos Labs finds itself. Though preparations for the launch of what must surely be a candidate for the title of “Best financed startup in history” have been rumoured for months, the firm formally announced itself, and its modus operandi, on January 19th. And, even at \$3bn, its proposed product might be thought cheap at the price. For the alchemy its founders, Rick Klausner, Hans Bishop and Yuri Milner, hope one day to offer the world is an elixir of life.

Others have tried this in the past. In 2013 an outfit called Calico Life Sciences was set up under the aegis of Google (now Alphabet), with Larry Page, one of that firm’s founders, as an interested party. It has yet to generate a product. In the same year Craig Venter, who ran a private version of the human genome project, and Peter Diamandis, who started the X Prize Foundation, got together to launch Human Longevity, though they subsequently fell out. That company, too, has gone quiet. And there are a string of other hopefuls in the field, many with billionaires like Dr Milner and Mr Page lurking in the background. Indeed, there are rumours, which Altos will not confirm, that Jeff Bezos is one of its investors—for the prolongation of life is a field that seems particularly attractive to the man (and it usually is a man) who otherwise has everything.

| *A walk in the hills*

The founders of Altos do, though, seem deadly serious about what they are up to. Looking at discoveries in biology made over the past few decades—two of these, in particular—they believe they have glimpsed the

outline of an answer to the question of how to reverse the process of cellular ageing. They have also recruited a star-studded scientific cast to help them track that answer down. Illnesses potentially in their cross-hairs include cognitive disorders and neurodegeneration, diabetes and associated metabolic problems, and cancer. Dealing with these might not, in the end, greatly extend average life spans. But it would surely increase what is known in the argot as healthspan.

The idea that became Altos was dreamed up by Dr Klausner, a former head of America's National Cancer Institute, and Dr Milner, an entrepreneur and venture capitalist with fingers in many technological pies, in a series of covid-escaping walks in Los Altos, a hilly, well-heeled suburb on the edge of Silicon Valley. They then recruited Mr Bishop, formerly boss of GRAIL, a cancer-detection company, to be the business brains.

The two findings around which the firm is built are Yamanaka transcription factors and the integrated stress-response (ISR) pathway. Yamanaka factors, discovered in 2006 by Yamanaka Shinya of Kyoto University, are four gene-regulating proteins which serve, in essence, to return a cell to factory settings. In this case "factory settings" means a state known as pluripotency that is enjoyed by embryonic stem cells. Pluripotent cells are those that can give rise to descendants capable of differentiating into a wide variety of specialised cells.

Early experiments involving the induction of Yamanaka factors in laboratory animals often caused tumours called teratomas, in which cells turn into weird mixtures of tissues. It has subsequently been discovered, though, that a partial reset avoiding this problem is possible by turning the relevant genes on only briefly. This results in a return to youthful rude health without "unspecialising" the cells involved. Experiments on mice have shown how that can stop the progression of progeria, a mutation-induced syndrome that mimics rapid ageing, can promote the healing of

injured muscles, and can protect the liver against damage by paracetamol, a widely used painkiller.

In contrast to the Yamanaka factors, which have a clear discovery date, the idea of an ISR pathway has emerged gradually. One of biology's most important concepts is homeostasis, the maintenance of a constant internal environment in the face of external pressure to change. The ISR does this at a cellular level. If a source of cellular stress is detected—be it external, such as oxygen or nutrient-deprivation, or viral infection; or internal, such as an accumulation of misfolded proteins or the activation of a potentially cancer-causing gene—the ISR switches on an emergency program to reset protein manufacturing. If this does not clear the problem, it then presses the self-destruct button, blowing up the cell it is in, in a process called apoptosis, to stop it becoming a locus of disease.

| *Pick'n'mix*

These two discoveries offer, in the founders' view, ways to bring sick cells back to health by resetting malfunctioning ISR pathways, and to give healthy cells that are getting on a bit in years a tonic. The initial plan is to look into this at three campuses, in Cambridge, England, the Bay Area of California and San Diego. The institutes in these will be led by Wolf Reik, Peter Walter and Juan Carlos Izpisua Belmonte respectively. Each will house, in its turn, about half a dozen research groups investigating various aspects of the problem.

Dr Reik, plucked from the Babraham Institute, an independent biomedical-research laboratory near Cambridge, is an expert in a field called epigenetic gene regulation. Tinkering with this process, in which gene expression is controlled by the way DNA is packed into chromosomes, is how the Yamanaka factors operate. Dr Walter, until now at the University of California, San Francisco, studies the behaviour of proteins inside cells. He has been involved from the beginning in mapping the ISR pathway. And Dr

Izpisua Belmonte, who ran the Gene Expression Laboratory at the Salk Institute, in San Diego's northern suburb of La Jolla, is also deeply embroiled in studying the Yamanaka factors. Indeed, it was he who spotted their ability to rejuvenate without a full factory reset, with all the potential medical consequences that gives rise to. Previously, those seeking to turn Yamanaka factors to medical advantage were looking at stem-cell therapies to regenerate tissues already in the body and also at the idea of growing organs for transplant. Dr Izpisua Belmonte opened the third avenue of rejuvenative possibility that Altos seeks to exploit.

Dr Yamanaka, too, has volunteered—literally (he will not be paid). Indeed, it was through him that Dr Milner became interested in the question of ageing and rejuvenation. In 2013 he was among the first recipients of a Breakthrough prize, an award that Dr Milner and some like-minded Silicon Valley bigwigs dreamed up to try to give the Nobel Foundation a run for its money. Though he will not run an institute, he will help gather a network of collaborators in his native country.

The last piece of the scientific jigsaw—almost inevitable these days—is artificial intelligence (AI). This is the purview of Thore Graepel, until now one of the leading lights in Google DeepMind. Modelling what is going on inside cells, which are composed of millions of molecules of thousands of varieties, is the sort of problem that would be unapproachable without AI. And the field is now starting to grapple with it, as shown by the recent success of DeepMind's AlphaFold program, which is able to predict from a protein's chemical structure how it will fold up into a functional shape. Dr Graepel's software will try to make sense of the outpourings of data from the firm's investigators.

Moreover, in case this list (which includes only one Nobel laureate, Dr Yamanaka himself) is not thought glittering enough, the firm's board sports three others: David Baltimore, a biological polymath, who won his for his

work on viruses; Jennifer Doudna, joint-inventor of a gene-editing technique called CRISPR-Cas9 that has boosted biotechnology; and Frances Arnold, who won her prize for work on directing the evolution of enzymes.

How, then, will it all play out? The biggest risk may be that the participants have jumped too early. The nitty-gritty of what they will be doing, at least in the firm's salad days, is pretty much what they would have been doing anyway, in their old jobs, except with bigger budgets. The flip side of this is that there is nothing immediately to hand that might be developed into a commercial product.

Three billion dollars is a big financial cushion, though. It gives leeway for changes of direction and recovery from mistakes. It will also, as Bob Nelsen, whose firm, ARCH Venture Partners, is on board to the tune of a sum north of \$250m, its biggest ever investment, observes, allow Altos to build its own development arm, and not have to rely, as lesser startups often do, on selling its intellectual property to an existing pharmaceutical company.

Not having a clear product from the get-go does not, then, seem to be a problem—though Mr Nelsen does mention boosting T-cell responses in the immune systems of the elderly and dealing with badly functioning islet cells in the pancreases of people with diabetes as early possibilities. Everyone involved seems confident that salable products will emerge.

| *Re-record, don't fade away*

Altos's founders are thus imitating old-fashioned corporate laboratories of the sort epitomised by Bell Labs, except without Ma Bell, then America's telephone monopoly, at their back. Bell hired bright people and let them get on with it, too. That resulted in the transistor and the laser. But those were products of physics, not biology. And the Altos approach seems similar to that taken by Calico Life Sciences, which has not worked so well—though

Hal Barron, appointed as Altos's chief executive, was once Calico's head of research, and might have ideas why not.

More fundamentally, there are doubts about how controllable the underlying biology of ageing really is. Despite appearances, multicellular organisms do not simply wear out in the ways that machines do. Like everything else in biology, the process of senescence is regulated by natural selection. The details are debated. But an overarching principle, called disposable-soma theory, seems to govern what is going on.

Disposable-soma theory starts from the premise that, for an individual, death is inevitable. Accident, infection, a predator or a rival will get you in the end. It therefore makes sense for evolution to care more about individuals when they are young than when they are old, since by then they may have died or been killed anyway.

Lots of things about ageing make sense from this perspective. Genes can have bad effects in old age as long as they have good ones during youth. Repairs need not be perfect—just successful enough to keep the show on the road. Anti-cancer mechanisms need to be tip-top for the first decades of life, but can get slacker with time. As can the immune system. Though they will, no doubt, build outward from their starting point, Altos's researchers will surely have to incorporate more aspects of molecular biology than those they are beginning with, in order to cover these bases.

The counterargument, put by Dr Klausner and his colleagues, is that resetting the clock is a natural process. It happens every generation. The reproductive cells which create these new generations get a fresh start each time. They really do return to factory settings. And if the clock can be reset for those cells, why not others? Whether Dr Milner, Mr Nelsen and the others who have backed the firm see a return on their investment will depend, above all, on the answer to that question. But it will be fascinating

to see it asked. ■



生物科技

押注30亿美元寻找青春之泉

一只速成独角兽能攻克细胞回春难题吗？【深度】

创业公司来来去去，犹如走马灯。但没有几家刚起步银行帐面上就有30亿美元。而Altos Labs的出身就是这么阔绰。它完全有资格竞争“史上融资最多的创业公司”的头衔。有关这家公司正在筹备创建的消息流传了好几个月，但到1月19日它才正式宣布成立并公布了商业模式。而即使是30亿美元的身价，对于这家公司计划推出的产品来说可能都算低了。因为公司创始人里克·克劳斯纳（Rick Klausner）、汉斯·毕晓普（Hans Bishop）和尤里·米尔纳（Yuri Milner）希望有朝一日为世界献上一剂长生不老的神方。

其他公司也有过这样的尝试。2013年，一家名为Calico Life Sciences的公司在谷歌（现在的Alphabet）的支持下成立，谷歌创始人之一拉里·佩奇也有份参与。目前该公司还没有任何产品问世。同年，主持私人版人类基因组计划的克雷格·文特尔（Craig Venter）和创办了X奖基金会（X Prize Foundation）的彼得·迪亚曼迪斯（Peter Diamandis）共同创办了人类长寿公司（Human Longevity），但后来二人不欢而散，这家公司也就此沉寂。这个领域还有一长串雄心勃勃的公司，许多都有像米尔纳和佩奇这样的亿万富翁在背后支持。事实上，一些Altos不愿证实的传言称，贝索斯是它的投资者之一，毕竟延长寿命这个领域似乎特别吸引这个除了长生不老以外什么也不缺的男人（通常也都是男人）。

| 山中散步

不过，Altos的创始人看起来绝对是玩真的。在回顾了过去几十年生物学领域的发现之后（特别是其中的两项发现），他们相信自己已经依稀瞥见了能逆转细胞衰老过程的办法。他们还招募了星光熠熠的科研团队来研究这个方案。他们可能要攻克的疾病包括认知障碍和神经退行性病变、糖尿病和相关代谢问题，以及癌症。对抗这些疾病最终可能不会大幅延长平均

寿命，但肯定能延长专业人士所说的健康寿命。

Altos的雏形是克劳斯纳和米尔纳在散步时聊出来的。克劳斯纳是美国国家癌症研究所（National Cancer Institute）的前主管，米尔纳是涉足众多科技领域的企业家和风投家。疫情期间，两人经常在硅谷边缘丘陵起伏的富裕郊区洛斯阿尔托斯（Los Altos）一起散步透透气。后来他们又请来癌症筛查公司GRAIL的前任老板毕晓普负责商业运营方案。

公司围绕两项科学发现而建：山中转录因子和整合应激反应（ISR）路径。京都大学的山中伸弥于2006年发现的山中因子是四种基因调节蛋白，其作用从本质上来说就是让细胞恢复“出厂设置”。这里的出厂设置是指胚胎干细胞所处的多能状态。多能细胞最终可以分化成多种特化细胞。

在早期实验中，在实验室动物体内诱导山中因子经常会导致名为畸胎瘤的肿瘤，其内部的细胞会形成奇怪的多种组织混合物。不过后来发现，只要短暂打开相关基因从而让细胞部分“重置”，就可以避免出现畸胎瘤。其结果是不需要把所涉及的细胞“非特化”，就恢复到了富有活力的年轻状态。小鼠实验表明，这可以阻止早衰症（一种基因突变诱发的综合征，症状为快速衰老）的发展，还可以促进受伤肌肉的恢复，并保护肝脏免受广泛使用的止痛药扑热息痛的损害。

与有明确发现时间的山中因子相比，对ISR路径的认识是一个渐进的过程。生物学最重要的概念之一是体内平衡，即在外部压力迫使做出改变之时维持稳定的体内环境。ISR维持的是细胞内的平衡。如果检测到细胞应激源，无论是外部应激源，如缺乏氧气或营养或是病毒感染，还是内部应激源，如错误折叠的蛋白质积累或潜在致癌基因被激活等，ISR都会启动紧急程序，重置蛋白质制造。如果这还不能解决问题，它就会按下自毁按钮，毁掉它所在的细胞（这个过程叫作细胞凋亡），从而阻止疾病在此处生成。

| 精英团队

在Altos的创始人看来，这两个发现给出了方法，可以通过重置失灵的ISR

路径来让生病的细胞恢复健康，并让开始老化的健康细胞回春。公司初步计划在分别设立于英国剑桥、加利福尼亚湾区和圣地亚哥的三个研究所对此展开研究。这些研究所将分别由沃尔夫·雷克（Wolf Reik）、彼得·华尔特（Peter Walter）和胡安·卡洛斯·伊斯皮舒·贝尔蒙特（Juan Carlos Izpisua Belmonte）领导。每个研究所将分别设置五六个研究小组，从不同方面研究这一课题。

雷克是公司从剑桥附近的独立生物医学研究实验室巴布拉汉研究所（Babraham Institute）挖来的，他是研究“表观遗传基因调控”的专家。在这个调控过程中，基因表达由染色体中DNA的构成方式来控制。而山中因子正是通过干预这个过程来发挥作用。沃尔特此前一直在加州大学旧金山分校研究细胞内蛋白质的行为。他从一开始就参与了绘制ISR路径的工作。贝尔蒙特曾在圣地亚哥北郊拉霍亚（La Jolla）的索尔克研究所（Salk Institute）领导基因表达实验室（Gene Expression Laboratory），也深度参与了对山中因子的研究。事实上，正是他发现了这些因子能在不完全恢复“出厂设置”的情况下恢复细胞活力，以及由此而来的所有潜在医学影响。在此之前，那些试图让山中因子转变成医学优势的人研究用干细胞疗法来再生体内已有组织，以及培育用于移植的器官。贝尔蒙特开辟了抗衰老这第三种可能的应用，这正是Altos想要一探究竟的。

山中伸弥也已志愿加入队伍——是真的志愿（他不会得到报酬）。事实上，米尔纳正是通过他才开始对衰老和抗衰老问题产生兴趣。2013年，山中伸弥成为科学突破奖（Breakthrough prize）的首批获奖者之一，该奖项由米尔纳和一些志同道合的硅谷大佬共同发起，想要挑战诺贝尔基金会的权威地位。虽然他不会负责哪个研究所，但会帮助在日本召集各方面的合作者。

这幅科学拼图中的最后一块是如今几乎哪个领域都避不开的人工智能（AI）。这一块由索尔·格雷佩尔（Thore Graepel）管辖，在加入公司之前，他是谷歌DeepMind的顶尖人物之一。由于细胞由数百万个分子组成，这些分子有数千个种类，如果没有AI，根本无法对细胞的内部机制建模。AI圈子目前已着手解决这个问题，DeepMind的AlphaFold程序最近取

得的成功就是例证。该程序能够根据蛋白质的化学结构预测它将如何折叠成为功能性结构。格雷佩尔的软件将尝试理解公司的研究人员提供的大量数据。

此外，如果觉得这份名单（其中仅有山中伸弥是诺贝尔奖获得者）还不够亮眼，那公司董事会里还有另外三位诺奖得主，分别是因病毒研究而获奖的生物学大家大卫·巴尔的摩（David Baltimore）、推动了生物技术发展的CRISPR-Cas9基因编辑技术的联合发明人詹妮弗·杜德纳（Jennifer Doudna），还有凭借研究酶的定向进化而获奖的弗朗西斯·阿诺德（Frances Arnold）。

那么，这样一家公司的前景会如何呢？最大的风险可能是这些参与者过早离开。至少在公司成立之初，他们所做的工作和留在原来的岗位上本来也会做的事并没有太大差别，只是现在拿到了更多预算。这种情况下不利的一面就是短期内拿不出什么可以变成商业产品的东西。

不过30亿美元是个很大的资金保障，让公司有余地改变研究方向和修正错误。而且正如投资方鲍勃·尼尔森（Bob Nelsen）所说，它还会让Altos能够成立自己的开发部门，而不必像较小的创业公司那样常常要依赖于向老牌制药公司出售知识产权。尼尔森的公司ARCH Venture Partners同意对Altos投资超过2.5亿美元，这是该公司有史以来最大的一笔投资。

因此，一开始没有明确的产品似乎不是个问题，尽管尼尔森确实提到，初期的方向可能是增强老年人免疫系统中的T细胞应答和攻克糖尿病患者胰腺中的胰岛细胞功能障碍。所有参与其中的人似乎都相信会出现可上市的产品。

| 重置时钟，不再凋亡

由此可见，Altos的创始人正在模仿以贝尔实验室为代表的那种老式企业实验室，只不过背后没有像“贝尔大妈”（当时的美国电话垄断巨头）这样的企业支持。贝尔也是请来了顶尖人才，让他们放手去做。这为世界带来了晶体管和激光器。但这都是物理学研究的产物，不是生物学的。Altos

的做法似乎与Calico Life Sciences相似，后者并不太成功——出任Altos首席执行官的哈尔·巴伦（Hal Barron）也许知道其中缘由，他曾担任Calico的研究主管。

更根本的问题是，人们质疑衰老底层的生物学机制到底是否可控。无论表面上看起来如何，多细胞生物老化的过程不像机器那样简单。和生物学中的其他一切一样，衰老过程受到自然选择的调节。具体过程仍未有定论。但是，一个被称为一次性体细胞理论的基本原则似乎控制着衰老过程。

一次性体细胞理论所基于的假定是，对于个体生命来说，死亡不可避免。意外、感染、捕食者或竞争对手最终都会要了你的命。因此，进化更在意个体年轻而不是年老的阶段是合理的，因为他们可能等不到完全衰老就已经死亡或被杀了。

从这个角度来看，衰老的很多方方面面都是说得通的。基因只要在年轻时发挥好作用就行，年老时出问题没什么关系。对基因的修复不一定要完美，能继续发挥作用即可。抗癌机制需要在生命的最初几十年中处于最佳状态，但之后可以松懈一些。免疫系统也是一样。Altos的研究人员无疑会立足最初的研究范围，但他们肯定需要比刚起步时纳入更多分子生物学方面的不同研究来处理这些问题。

克劳斯纳和他的同事提出的反面观点是，重置时钟是一个自然过程。它发生在每一代细胞上。创造新一代细胞的生殖细胞每次都有新的开始。它们确实都恢复到了“出厂设置”。如果这些细胞可以重置时钟，其他细胞为什么不行？米尔纳、尼尔森和其他Altos投资者能否得到回报，关键将取决于这个问题的答案。但是，把这个问题提出来就将带来迷人的风景。■



Bartleby

Purpose and the employee

Some people want to change the world. But not everyone

WHAT IS THE meaning of mayonnaise? For Unilever, a consumer-goods giant whose products are all meant to stand for something, the purpose of its Hellmann's brand is to reduce food waste by making leftovers tasty. For Terry Smith, a fund manager fed up with Unilever's dipping share price, this is crazy. "The Hellmann's brand has existed since 1913," he wrote last month. "So we would guess that by now consumers have figured out its purpose (spoiler alert—salads and sandwiches)."

Mr Smith's concern is the financial performance of Unilever (in the face of investor disquiet, the firm is now planning management cuts and an overhaul of its operating model). But his underlying point, that doing the obvious job well can be purpose enough, is one that has much wider application. For it is true of colleagues as well as condiments.

The very idea of a purposeful employee conjures up a specific type of person. They crave a meaningful job that changes society for the better. When asked about their personal passion projects, they don't say "huh?" or "playing Wordle". They are concerned about their legacy and almost certainly have a weird diet.

Yet this is not the only way to think about purpose-driven employees. New research from Bain, a consultancy, into the attitudes of 20,000 workers across ten countries confirms that people are motivated by different things.

Bain identifies six different archetypes, far too few to reflect the complexity of individuals but a lot better than a single lump of employees. "Pioneers" are the people on a mission to change the world; "artisans" are interested in

mastering a specific skill; “operators” derive a sense of meaning from life outside work; “strivers” are more focused on pay and status; “givers” want to do work that directly improves the lives of others; and “explorers” seek out new experiences.

These archetypes are unevenly distributed across different industries and roles. Pioneers in particular are more likely to cluster in management roles. The Bain survey finds that 25% of American executives match this archetype, but only 9% of the overall US sample does so. Another survey of American workers carried out by McKinsey, a consulting firm, in 2020 found that executives were far likelier than other respondents to say that their purpose was fulfilled by their job.

This skew matters if managers blindly project their own ideas of purpose onto others. Having a purpose does not necessarily mean a desire to found a startup, head up the career ladder or log into virtual Davos. Some people are fired up by the prospect of learning new skills or of deepening their expertise.

Others derive purpose from specific kinds of responsibility. Research by a couple of academics at NEOMA Business School and Boston University looked at the experience of employees of the Parisian metro system who had been newly promoted into managerial roles. People who had been working as station agents before their elevation were generally satisfied by their new roles. But supervisors who had previously worked as train drivers were noticeably less content: they felt their roles had less meaning when they no longer had direct responsibility for the well-being of passengers.

Firms need to think more creatively about career progression than promoting people into management jobs. IBM, for example, has a fellowship programme designed to give a handful of its most gifted technical employees their own form of recognition each year.

Another mistake is to conflate an employee's commitment with good performance. A recent paper from Yuna Cho of the University of Hong Kong and Winnie Jiang of INSEAD, a business school, describes an experiment in which groups of people with managerial experience listened to two actors playing the part of colleagues. One group heard an "employee" saying that he was looking forward to retirement; another group heard the employee saying that he did not want to retire at all. In all other respects the conversations were the same. The observers assigned a bigger bonus and a higher raise to the employee who appeared to have more passion.

There is some logic here. Employees with a calling could well be more dedicated. But that doesn't necessarily make them better at the job. And teams are likelier to perform well if they blend types of employees: visionaries to inspire, specialists to deliver and all those people who want to do a job well but not think about it at weekends. Like mayonnaise, the secret is in the mixture. ■



巴托比

使命和员工

有人想改变世界。但不是人人都想

蛋黄酱存在的意义是什么？消费品巨头联合利华的所有产品如今都为了某种主张而存在，它的赫尔曼斯品牌（Hellmann's）的使命就是让剩饭变得好吃，从而减少食物浪费。受够了这家公司股价跌个不停的基金经理特里·史密斯（Terry Smith）觉得这太扯了。“赫尔曼斯品牌自1913年起就存在了，”他在上月写道，“所以我们猜测，到了今天消费者已经清楚它的使命是什么了（剧透警告：沙拉和三明治）。”

史密斯担心的是联合利华的财务表现（面对投资者的不安，该公司正在计划削减管理层并彻底改革运营模式）。但他这句话隐含了一层意思：把显而易见的职责做好就足以构成使命了。这个观点的适用范围远不止这家公司。因为它不仅对调味品适用，对员工也是如此。

提起有使命感的员工，总会让人联想起一种特定类型的人。他们渴望做一份能把社会变得更好的有意义的工作。当被问及他们个人有什么爱好时，他们不会说“啊？”或者“玩Wordle”。他们关心自己能给社会留下什么。而且他们几乎肯定有着某种古怪的饮食习惯。

但看待使命驱动的员工不是只有这一种思路。咨询公司贝恩（Bain）的一项新研究调查了10个国家的两万名员工的工作态度，证实了人们受到激励的因素各有不同。

贝恩确定了六种最典型的类型，这个数目远不能反映个体的复杂性，但还是比把所有员工一概而论好得多。“拓荒者”肩负改变世界的重任；“匠人”对掌握一项特定技能感兴趣；“操作者”从工作之外的生活中收获意义；“奋斗者”更专注于薪酬和地位；“给予者”想做直接改善他人生活的工作；而“探险者”追求新的体验。

这几种类型在不同的行业和角色中分布不均。特别是拓荒者更有可能聚集在管理角色中。贝恩的调查发现，25%的美国高管符合这一类型，但在整个美国样本中属于这一类型的人只有9%。咨询公司麦肯锡在2020年针对美国劳动者的另一项调查发现，相比其他受访者，高管表示工作让他们达成了自身使命的可能性要高得多。

如果管理者一味将自己对使命的想法投射到他人身上，问题就来了。有使命感并不一定会渴望成立一家创业公司、在职场平步青云或登录虚拟达沃斯论坛。有些人对有可能学到新技能或精进自身专长满腔热情。

其他人从特定种类的责任中生发出使命感。诺欧商学院（NEOMA Business School）和波士顿大学的几名学者的研究考察了巴黎地铁系统的一些员工的经历，这些人新近晋升了管理职位。在晋升之前一直担任车站工作人员的人基本上都对自己的新角色感到满意。但是，以前是列车司机的主管明显没那么心满意足：当他们不再对乘客的福祉负有直接责任时，他们觉得自己的角色没那么有意义了。

公司在考量员工的职业发展时需要更有创造性，而不是把人提上管理岗位就好。例如，IBM推出了一个奖励机制，每年向少数最有才干的技术人员提供他们专属的表彰形式。

还有一个错误是将员工的工作热情和好表现混为一谈。香港大学的赵润雅和欧洲工商管理学院（INSEAD）的江韵近期发表了一篇论文，描述在—项实验中，两组有管理经验的人员听取两名扮演自己同事的演员的讲述。—组听到的是一个“员工”说他期待退休，另一组听到的是他根本不想退休。谈话的其他内容完全相同。聆听者们给看起来更有工作热情的“员工”分配了更丰厚的奖金和更大幅度的加薪。

这个结果有一定的道理。受使命感召的员工很可能会更敬业。但这并不—定就让他们更加胜任某项工作了。而如果团队中融合了不同类型的员工就—更有可能表现出彩——比如有鼓舞人心的远见者、不负所望的行家里手，以及所有想把工作做好但不想在周末也想着工作的人。就像蛋黄酱—样，

秘诀就在于搭配混合。■



Rewebbing the net

Will web3 reinvent the internet business?

In parts, yes. But probably not as sweepingly as its boosters reckon

LIKE NEARLY everyone these days, Moxie Marlinspike has created a non-fungible token (NFT). These digital chits use clever cryptography to prove, with no need for a central authenticator, that a buyer owns a unique piece of digital property. Alongside cryptocurrencies like bitcoin, NFTs are the most visible instantiation of “web3”—an idea that its advocates and their venture-capital (VC) backers hail as a better, more decentralised version of the internet, built atop distributed ledgers known as blockchains.

Technologists like Mr Marlinspike, who created the secure-messaging app Signal, digital artists, celebrities and even the occasional newspaper have issued and sold them to collectors, often for hefty sums (an immaterial version of The Economist’s cover image fetched over \$400,000).

Although it looked as cryptographically sound as any other NFT, though, Mr Marlinspike’s token could shift shape depending on who opened it. If you bought it and viewed it on a computer, it transformed into a poop emoji. After a few days the NFT was taken down by OpenSea, a marketplace for digital artefacts. This played into Mr Marlinspike’s hands. For his aim was not to raise cash but to raise awareness. His token showed that NFTs are not as non-fungible as advertised. And OpenSea’s reaction illustrated that the supposedly decentralised web3 has its own gatekeepers.

| *Can the centre hold?*

The Marlinspike caper was the latest turn in perhaps the biggest controversy to erupt in tech-world for several years. On one side sit techno-Utopians, firms offering assorted web3 services and their VC backers. They claim that web3 is the next big thing in cyberspace, that it is truly

decentralised—and that it promises juicy returns to boot. Globally, the value of VC deals in the crypto-sphere reached \$25bn last year, up from less than \$5bn in 2020 (see chart). Last month Andreessen Horowitz, one of Silicon Valley’s most illustrious VC firms, its biggest web3 champion and a16z for short, was reported to be raising a \$4.5bn web3-related fund, to add to three existing ones worth a total of \$3bn. A senior partner left a16z last month to set up her own firm focused on web3.

Pitted against them are the sceptics. They range from Mr Marlinspike, respected even among the techno-Utopians, to Jack Dorsey, who founded two platforms of the sort that web3 promises to supersede (Twitter in social media and Square in payments). They argue that a decentralised internet is a pipe dream—“You don’t own ‘web3’. VCs and their [limited partners] do,” Mr Dorsey warned in December. And a dangerous one at that for the unwary investor: since November some \$1trn of the value of cryptocurrencies, the most mature province of web3, has gone up in flames.

The feud may seem abstruse. But the stakes are big. It could change the trajectory of the internet—and the multitrillion-dollar business models that it has enabled.

The history of modern computing is of a constant struggle between decentralisers and recentralisers. In the 1980s the shift from mainframes to personal computers gave individual users more power. Then Microsoft clawed some of it back with its proprietary operating system. More recently, open-source software, which users can download for nothing and adapt to their needs, took over from proprietary programs in parts of the industry—only to be reappropriated by the tech giants to run their mobile operating systems (as Google does with Android) or cloud-computing data centres (including those owned by Amazon, Microsoft and Google).

The web3 movement is a reaction to perhaps the greatest centralisation of

all: that of the internet. As Chris Dixon, who oversees web3 investments at a16z, explains it, the original, decentralised web lasted from 1990 to about 2005. This web1, call it, was populated by flat web pages and governed by open technical rules put together by standards bodies. The next iteration, web2, brought the rise of tech giants such as Alphabet and Meta, which managed to amass huge centralised databases of user information. Web3, in Mr Dixon's telling, "combines the decentralised, community-governed ethos of web1 with the advanced, modern functionality of web2".

This is possible thanks to blockchains, which turn the centralised databases to which big tech owes its power into a common good that can be used by anybody without permission. Blockchains are a special type of ledger that is not maintained centrally by a single entity (as a bank controls all its customers accounts) but collectively by its users. Blockchains have outgrown cryptocurrencies, their earliest application, and spread into NFTs and other sorts of "decentralised finance" (DeFi). Now they are increasingly underpinning non-financial services.

The portfolio of a16z offers a glimpse of this wild new world. It already includes more than 60 startups, at least a dozen of which are valued at over \$1bn. Many are developing the infrastructure for web3. Alchemy provides tools for others to build blockchain applications, much as cloud computing makes it easy for developers to create web-based services. Nym's "mixnet" is a decentralised network that mixes up messages so that no one else can tell who is sending what to whom.

Other a16z bets are serving end-users. Dapper Labs creates NFT applications such as NBA Top Shot, a website where sports fans can buy and sell digital collectables like depictions of key moments in basketball games. Syndicate helps investment clubs organise themselves into "decentralised autonomous organisations" governed by "smart contracts", which are rules encoded in software and baked into a blockchain. And Sound.xyz allows

musicians to mint NFTs to make money.

What all these companies have in common, explains Mr Dixon, is that it is hard for them to lock in customers. Unlike Google and Meta they do not control their users' data. OpenSea (in which a16z also has a stake) and Alchemy are just pipes to the blockchain. If their customers are unhappy, they can move to a competing service. Even if he wanted, he could not keep them from leaving, says Nikil Viswanathan, Alchemy's boss. "As a business, I would love to have proprietary choke points. But there aren't any. We tried to find them."

The idea is that this makes web3 companies try harder to satisfy customers and keep innovating. Whether they can do this while also making pots of money is another matter. It is not clear how much demand exists for truly decentralised projects. That was the problem of early web3 offerings (then called "peer-to-peer" or "the decentralised web"). Services such as Diaspora and Mastodon, two social networks, never really took off. Their successors could face the same problem. A service like OpenSea would be much faster, cheaper and easier to use "with all the web3 parts gone", says Mr Marlinspike.

A more fundamental problem is that even if web3 worked as smoothly as its immediate predecessor, it may nevertheless lend itself to centralisation. Lock-in, reckons Mr Marlinspike, tends to emerge almost automatically. The history of the internet has shown that collectively developed technical protocols evolve more slowly than technology devised by a single firm. "If something is truly decentralised, it becomes very difficult to change, and often remains stuck in time," he writes. That creates opportunities: "A sure recipe for success has been to take a 1990's protocol that was stuck in time, centralise it, and iterate quickly."

Centralisation and lock-in have been incredibly lucrative. In fact, a16z has

made billions from Meta, in which it was an early investor; one of a16z's founders, Marc Andreessen, sits on Meta's board to this day. Web3's VC boosters may be counting on something like this happening again. And to a degree, it already is. Despite being a relatively recent phenomenon, web3 is exhibiting signs of centralisation. Because of the complexity of the technology, most people cannot interact directly with blockchains—or find it too tedious. Rather they rely on middlemen, such as OpenSea for consumers and Alchemy for developers.

Albert Wenger of Union Square Ventures, a VC firm that started investing in web3 firms a few years ago, points to other potential “points of recentralisation”. One is that the ownership of the computing power that keeps many blockchains up to date is often very concentrated, which gives these “miners”, as they are called, undue influence. It could even allow them to take over a blockchain. In other systems the ownership of tokens is heavily skewed: at recently launched web3 projects, between 30% and 40% is owned by the people who launched them.

These dynamics, combined with the latest crash that may cool investors' appetite for all things crypto, suggest that web3 will not dislodge web2. Instead, the future may belong to a mix of the two, with web3 occupying certain niches. Whether or not people keep splurging on NFTs, such tokens make a lot of sense in the metaverse, where they could be used to track ownership of digital objects and move them from one virtual world to another. Web3 may also play a role in the creator economy, another buzzy concept. Li Jin of Atelier, a VC firm, points out that NFTs make it easier for creators of online content to make money. In this limited way, at least, even the masters of web2 see the writing on the wall: on January 20th both Meta and Twitter integrated NFTs into their platforms. ■



重织网络

web3会重塑互联网行业吗？

会部分重塑。但可能不像其支持者预想的那么彻底

就像现在几乎人人都在做的一样，莫西·马林斯派克（Moxie Marlinspike）也创建了一个非同质化代币（NFT）。这种数字凭证使用精巧的加密技术，不需要中央认证者便能证明买家拥有一件独一无二的数字财产。除了比特币等加密货币，NFT是“web3”最显而易见的实例。web3建立在被称为“区块链”的分布式账本之上，它的拥趸及风险投资者赞颂它是一种更好的、更去中心化的互联网。马林斯派克（他创建了加密即时通信应用Signal）等技术专家、数字艺术家、名人，甚至是报纸特刊，都向收藏者发行并出售NFT，而且通常售价不菲（本刊非实物版的封面图片以超过40万美元售出）。

尽管从加密的角度看，马林斯派克的代币和其他所有NFT一样可靠，但它会基于打开它的人而呈现不同的样子。如果你买下后在电脑上查看，它就会变成大便的表情符号。没几天，这个NFT就被数字藏品市场OpenSea下架了。这正中马林斯派克的下怀。因为他的目的不是筹钱，而是要提请人们注意。他的代币表明，NFT并不像宣传的那样非同质化。而OpenSea的反应也表明，所谓去中心化的web3也有自己的看门人。

| 中心还守得住吗？

马林斯派克的戏法是一场论战的最新转折。这场论战或许是近些年科技圈爆发的最大的一场。它的一边是技术乌托邦派、提供各种web3服务的公司及其风险投资人。他们声称web3是网络空间的下一个大事件，是真正去中心化的，并且肯定能带来丰厚的回报。从全球来看，去年加密领域的风投交易额达到250亿美元，而2020年不到50亿美元（见图表）。硅谷最著名的风投公司之一安德森-霍洛维茨（Andreessen Horowitz，简称a16z）也是硅谷最大的web3支持者，上月有报道称，它正在现有的总价值30亿美元的三只基金的基础上，再筹集一只45亿美元的web3相关基金。一位高级合

伙人上月离开了a16z，自己成立了一家专注web3的公司。

与之对立的一边是web3的怀疑者，其中有马林斯派克这样连一些技术乌托邦派也很尊敬的人物，也有杰克·多尔西（Jack Dorsey）这样所创建的两个平台（社交媒体领域的推特和支付领域的Square）都是web3的颠覆对象的人。他们指出，去中心化的互联网是个白日梦——“你并不拥有‘web3’。拥有它的是风投公司和它们的有限合伙人。”多尔西在12月警告道。而且对于不够谨慎警觉的投资者来说，这个梦还非常危险：自去年11月以来，在加密货币这一web3最成熟的领域中已有约一万亿美元的价值灰飞烟灭。

这场争论可能深奥难懂。但它利害攸关。它可能改变互联网的发展轨迹，以及互联网已促成的万亿美元计的商业模式。

现代计算的历史就是一部去中心化者和再中心化者持续斗争的历史。上世纪80年代，从大型主机向个人电脑的转变赋予了个人用户更多权力。随后，微软用自己专有的操作系统夺回了部分权力。更近些年，用户可以免费下载开源软件并根据自己的需求来调整它们，这取代了计算机行业里的一部分专有程序——结果却被科技巨头们再次掌控，用来运行它们自己的移动操作系统（比如谷歌的安卓）或云计算数据中心（包括亚马逊、微软和谷歌的云）。

“web3运动”是对互联网中心化——或许是迄今最大程度的一种中心化——所做出的反应。正如在a16z负责web3投资的克里斯·迪克森（Chris Dixon）所解释的那样，最初的去中心化网络从1990年持续到2005年左右。这就是人们所说的web1，由平面网页组成，通过各个标准组织共同制定的开放技术规则来治理。它的下一个迭代版本web2让Alphabet和Meta等科技巨头得以崛起，它们设法积累了庞大的中心化的用户信息数据库。用迪克森的话说，web3“结合了web1的去中心化的、社区治理的理念和web2的先进、现代的功能性”。

这因为区块链才成为可能。区块链把大型科技公司赖以称霸的中心化数据库变成了一种公共利益，所有人无需许可即可使用。区块链是一种特殊的

分类账，它不是由单个的实体集中维护（像银行控制其所有客户的账户那样），而是由其用户共同维护。区块链的发展已经超越了它最早的应用——加密货币，扩展到NFT和其他类型的“去中心化金融”（DeFi）。现在，它们正日渐成为非金融类服务的底层技术。

a16z的投资组合让人一睹这个狂野新世界。它已投资了60多家创业公司，且至少有12家估值超过10亿美元。许多公司正在开发web3的基础设施。Alchemy为其他公司提供构建区块链应用的工具，就像云计算使开发人员能够轻松创建基于web的服务一样。Nym的“mixnet”是个去中心化的网络，它把消息混合在一起，让其他人无法追踪谁向谁发送了什么消息。

a16z还投资了一些服务终端用户的公司。比如，Dapper Labs创建了NBA Top Shot网站等NFT应用，体育迷们可以在这个网站上买卖数字藏品，比如对篮球比赛中精彩瞬间的呈现。Syndicate协助各种投资俱乐部自我组织起来，成为由“智能合约”（即被编码在软件中并嵌入区块链的规则）管理的“去中心化的自治组织”。Sound.xyz让音乐家们可以通过铸造NFT来赚钱。

迪克森解释说，这些公司都有一个共同点，就是很难锁定客户。不同于谷歌和Meta，它们并不控制着自己用户的数据。OpenSea（a16z也持有其股份）和Alchemy只是通往区块链的管道。如果它们的客户不满意，就可以转向竞争对手的服务。Alchemy的老板尼基尔·维斯瓦纳坦（Nikil Viswanathan）说，就算自己想留住客户，也无能为力。“作为一家企业，我倒是想拥有卡脖子的专有工具。但是没有呀。我们费劲找过了。”

人们的想法是，这会让web3公司加倍努力满足客户需求，并不断创新。它们能否在做到这一点的同时还赚到大钱又是另一回事了。目前还不清楚对真正去中心化的项目的需求有多大。这就是早期web3产品（当时叫“点对点”即P2P，或“去中心化网络”）存在的问题。社交网络Diaspora和Mastodon等服务就从未真正流行过。它们的后继者可能面临同样的问题。像OpenSea这样的服务“如果去掉所有的web3特性”，就会快得多、便宜得多，也好用得更多，马林斯派克表示。

一个更根本性的问题是，即使web3像web2那样流畅地运行，也还是有可能带来中心化。马林斯派克认为，锁定效应往往近乎自动地出现。互联网的发展史已经表明，相比于单个公司开发的技术，共同开发的技术协议演进得更慢。“如果某个事物真的做到了去中心化，它就会变得非常难以改变，而且往往会停滞不前。”他写道。这就创造了机会：“过去一准成功的秘诀是，把一个1990年代停滞不前的协议拿来，将它中心化，并快速迭代。”

中心化和锁定效应带来了不可思议的利润。事实上，作为Meta的早期投资者，a16z已经靠Meta赚到了数十亿美元；a16z的创始人之一马克·安德森（Marc Andreessen）至今仍是Meta的董事。web3的风险投资人可能正在指望类似的事情再次发生。而在一定程度上，它已经发生了。尽管web3是个相对较新的现象，但它正显示出中心化的迹象。由于技术的复杂性，大多数人无法直接与区块链互动——或者觉得它太过单调乏味。他们倒是更依赖中间商，如面向消费者的OpenSea和面向开发人员的Alchemy。

风投公司Union Square Ventures几年前开始投资web3，该公司的艾伯特·温格（Albert Wenger）指出了其他潜在的“再中心化的触发点”。让许多区块链得以不断更新数据的运算能力的所有权往往非常集中，让这些被称为“矿工”的算力公司获得了过多的影响力。这甚至能让它们掌控一整个区块链。而在其他系统中，代币的所有权非常不均衡：在最近推出的web3项目中，三到四成的代币都在推出这些项目的人手中。

这些动态，加上最近加密货币的暴跌可能给投资者的加密热情降降温，表明web3不会把web2赶下台。相反，未来可能是两者的某种混合，其中web3将占据一些小众市场。无论人们是否继续在NFT上大肆投资，这种代币在元宇宙中都很有用处——它们可以被用来追踪数字物品的所有权，并把它们从一个虚拟世界转移到另一个虚拟世界。web3也可能在另一个热门概念“创作者经济”中发挥作用。风投公司Atelier的金丽芸指出，NFT让在线内容创作者更容易赚钱。至少从这有限的方面来说，即使是web2的主宰者也看到不祥之兆：1月20日，Meta和推特都把NFT整合进了自己的平台。■



After the party

When will the semiconductor cycle peak?

Busts follow booms in the chip business. Governments could make things worse

AMID A CHIP shortage that has hobbled producers of everything from toys to wind turbines, chipmakers are on a spending spree. On January 13th Taiwan Semiconductor Manufacturing Company (TSMC), the world's biggest contract manufacturer, said it would spend up to \$44bn on new capacity in 2022. That is up from \$30bn last year, triple the number in 2019 and ahead of earlier plans to spend over \$100bn in total over the next three years. Intel, an American rival, plans to burn through \$28bn this year. On January 21st it said it would build two big new factories in Ohio by 2025 at a total cost of \$20bn. An option to build six more later would take the overall price tag to \$100bn. Samsung of South Korea, TSMC's closest technological rival, has hinted that its capital spending for 2022 will surpass last year's \$33bn. Smaller firms, such as Infineon in Europe, are also splurging.

IC Insights, a research group, reckons that, across the industry, capital spending rose by 34% in 2021, the most since 2017. That torrent of money is welcome news for the industry's customers, who have been struggling with shortages for over a year. For the industry itself, it is the latest iteration of a familiar pattern. Bumper revenues, like those reported by Intel on January 26th and Samsung the next day, compel companies to expand capacity. But because demand can change much more quickly than the two or more years needed to build a chip factory, such booms often end in busts. The chip business has swung between over- and undercapacity since it emerged in the 1950s, observes Malcolm Penn of Future Horizons, a firm of analysts (see chart). If history is a guide, then, a glut is in on the way. The only question is when.

Soon, many analysts think. Demand for smartphones may be cooling,

especially in China, the world's biggest market. Sales of PCs, which boomed during covid-19 lockdowns, also seem poised to weaken, says Alan Priestley of Gartner, a research firm. A survey by Morgan Stanley, a bank, found that, partly thanks to the shortages, 55% of chip buyers were double-ordering, which artificially inflates demand. High inflation and looming interest-rate rises could hit economic growth—and chip demand with it. Mr Penn expects the cycle to turn in the second half of 2022 or in early 2023.

This time the glut, when it comes, may not affect all chipmakers equally. TSMC's boss, C.C. Wei, said this month that a correction could be "less volatile" for his firm thanks to its position at the technological cutting-edge. Much of its new capacity is already booked up in long-term agreements with customers such as Apple, which needs a regular supply of the most sophisticated chips for its newest iPhones.

The current cycle may differ from previous ones for another reason. The shortages, and America's tech-flavoured trade war with China, have reminded politicians how vital chips are to the modern economy—and how over-reliant their supply is on a few giant firms. Worries about the sector's excessive concentration have led trustbusters to challenge the \$40bn acquisition by Nvidia, an American chip designer, of Arm, a British one—successfully, if news reports this week that the deal is being scrapped are to be believed.

But governments' favoured way to deal with the over-reliance is to lure more chipmaking home, mostly from East Asia, with subsidies. On January 25th America's Commerce Department issued a report to that effect, urging Congress to pass a bill, already approved by the Senate, that includes \$52bn in handouts for chipmakers. Mark Liu, TSMC's chairman, was frank in 2020 when he said such subsidies were vital to persuade his firm to build a new plant in Arizona, one of only a few outside Taiwan. Intel chose Ohio for its factories partly because of incentives offered by the state. Pat Gelsinger, its

boss, has been touring rich places that have made similar offers.

The EU is keen to match the Americans, potentially putting itself on the hook for tens of billions of dollars of its own. It aspires to double Europe's share of chipmaking, currently around 10%. In May South Korea's government talked of a national mission to provide \$450bn of capital spending over ten years to protect and expand its national industry. In November Japan unveiled a scheme of its own, with TSMC thought to be getting some \$3.5bn. China has long nurtured ambitions—invigorated by American sanctions but so far unsuccessful—to build a fully fledged chip industry.

Adding taxpayer cash to chipmakers' already rich spending plans, says Mr Penn, could lead them to build even more excess capacity than usual. That should give politicians and chip CEOs pause. The bigger the boom, the deeper the subsequent bust.

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狂欢过后

这轮半导体周期何时见顶？

芯片业繁荣之后是萧条，政府可能火上浇油

从玩具到风力涡轮机，芯片短缺让各种产品的制造商都步履维艰，芯片制造商正大笔投资扩产。1月13日，全球最大的芯片代工厂台积电表示2022年将花费高达440亿美元增加产能，高于去年的300亿美元，是2019年的三倍。它原来的计划在未来三年总共投资1000亿美元，现在已经超前了。它的美国对手英特尔计划今年砸下280亿美元。1月21日，英特尔透露将在2025年前在俄亥俄州新建两家大型工厂，总投资为200亿美元，如果加上日后再建六家工厂的计划，总投入将达到1000亿美元。技术实力与台积电最接近的竞争对手韩国三星则暗示，2022年的资本支出将超过去年的330亿美元。规模较小一些的公司，比如欧洲的英飞凌（Infineon），也在大笔投资。

研究机构IC Insights估计，整个芯片业在2021年的资本支出总共增加了34%，是2017年以来的最大增幅。对一年多来一直苦于芯片短缺的客户来说，这样的资金洪流是好消息。对芯片业本身来说，这只是一个熟悉的模式再度上演。丰厚的收入（如英特尔在1月26日和三星在次日发布的财报所显示）驱使公司扩大产能。但建造一座芯片工厂至少要两年时间，而需求变化会快得多，因此这样的繁荣往往以萧条告终。芯片业分析公司Future Horizons的马尔科姆·佩恩（Malcolm Penn）指出，芯片业自上世纪50年代形成以来一直在产能过剩和产能不足之间摇摆（见图表）。若以史为鉴，那么可以预期产能过剩已经在来的路上了。唯一的问题它是何时到来。

很快——许多分析师认为。对智能手机的需求可能正在降温，尤其是在中国这个全球最大的市场。个人电脑在疫情封城期间销量激增，现在看来势必也会减弱，研究公司高德纳（Gartner）的艾伦·普利斯特利（Alan Priestley）指出。摩根士丹利的一项调查发现，芯片短缺在一定程度上导致55%的芯片买家重复订货，人为推高了需求。高通胀和加息逼近可能打

击经济增长，进而影响芯片需求。佩恩预计，这轮周期将在2022年下半年或2023年初见顶下行。

等这一次供应过剩出现时，对各家芯片制造商的影响也许会各不相同。台积电的CEO魏哲家1月表示，公司技术处于领先地位，受市场修正的影响可能“不会那么大”。台积电的大部分新产能已被客户通过长期协议预订掉了，比如苹果就需要获得最先进芯片的稳定供应来生产最新款iPhone。

还有另一个原因可能让本轮芯片周期有别以往。芯片短缺，加上美国对中国发起的贸易战大力冲击高科技产业，让政客们惊觉芯片对现代经济的重要性，他们开始意识到自己过度依赖少数巨头公司来供应芯片。由于担心芯片业过度集中，反垄断官员对美国芯片设计公司英伟达（Nvidia）以400亿美元收购英国同行安谋（Arm）的交易提出诉讼，若近日的相关报道属实，他们已成功让这宗交易流产。

但是，面对过度依赖的问题，政府倾向的解决方式是用补贴把更多的芯片生产（大部分从东亚）吸引到自己国家。1月25日，美国商务部就发布了这么一份报告，敦促国会通过一项参议院已批准的法案，其中包括向芯片制造商提供520亿美元的补助。台积电董事长刘德音在2020年坦言，这种补贴是说服台积电在亚利桑那州投建新厂（台湾以外仅有的几家工厂之一）的关键。英特尔选择在俄亥俄州建厂，也是考虑到该州提供的奖励措施。英特尔老板帕特·基尔辛格（Pat Gelsinger）一直在考察提出类似条件的富裕地区。

欧盟正积极跟上美国的脚步，可能要为此掏出数百亿美元。欧盟希望让欧洲在全球芯片制造业中的份额翻倍，目前约为10%。去年5月，韩国政府提出一项国家战略，在十年内提供4500亿美元的资本支出，保护并扩大其国家工业。11月，日本也公布了自己的计划，据估计台积电可藉此获得约35亿美元。中国一直雄心勃勃想打造成成熟完备的芯片产业，受到美国制裁后更是如此，但迄今并不成功。

佩恩表示，芯片制造商的支出计划本已庞大，再把纳税人的钱堆上去，

可能让它们酿造出比以往更多的过剩产能。这应该能让政客和芯片老板们消停了。爬得越高，之后跌得就越重。





Photography

A new type of camera

It could prove invaluable for robots, drones and driverless cars

CONVENTIONAL CAMERAS focus light onto a recording medium to preserve an image as a field of tiny dots. The media have changed over the years from plates of silver to plates of glass to acetate films to charge-coupled devices. The dots, meanwhile, have gone from being grains of chemicals to electronic pixels. But the principle has stayed the same. And moving pictures are simply streams of such images shown in sequence.

This arrangement is known as a frame camera. But there is now an alternative, the event camera. Unlike a frame camera, an event camera does not activate the dots simultaneously, using a physical or virtual shutter. Instead, a dot responds only when the nature of the incoming light changes.

Since changing light is frequently a consequence of movement, these cameras often record events rather than objects—hence their name. Though the data they record can, if desired, be used to reconstruct images of objects (see picture), they have other, better, uses, particularly if the camera in question is, itself, in motion.

For example, an event camera's modus operandi provides a quick and easy way of determining the rate at which objects are moving through its visual field—known in the argot as “optical flow”. Optical flow shows both how fast the camera is travelling and how close other things are to it, for nearby objects change position in its field more rapidly than do distant ones.

Insect eyes are natural examples of instruments optimised to record optical flow. That is why house flies are so good at judging speed and height—and

also how close an approaching swatter is. Taking their lead from these animals, Guido de Croon of the Delft University of Technology, in the Netherlands, and his colleagues used an event camera on a drone to judge speed during landing. This allowed the drone to make a controlled landing faster than was possible with a frame camera.

| *Events, dear boy*

A frame camera shooting 20 images a second supplies data at 50-millisecond intervals. Event cameras, unconstrained by such a fixed timetable, can respond in microseconds. Davide Scaramuzza, director of the Robotics and Perception Group at the University of Zurich, has, like Dr de Croon, been working with event cameras mounted on drones. Collision-detection cameras usually take 50-200 milliseconds to react. His team used an event camera to cut this below four milliseconds, enabling faster manoeuvring whilst avoiding obstacles.

Response time is equally important for self-driving cars. Dr Scaramuzza's team are working on event cameras for this application with what he terms a "top-tier" company in the automotive sector.

Event cameras bring benefits besides speed. Frame-based moving-picture cameras capture redundant information, such as areas of unchanging blue sky. To avoid wasting disk space and bandwidth, images taken this way are often compressed by special software, such as MPEG, for storage or transmission. But event-camera images do not require compression. According to Dr Scaramuzza, they are about 40 times as efficient in this respect as frame cameras.

On top of that, event cameras are practically immune to motion blur. Capturing images of speeding bullets is no problem, and they can film the hare and the tortoise at the same time with equal clarity. They could thus solve the perennial problem of extracting unblurred stills from closed-

circuit television feeds.

Yet another advantage of event cameras is that they cope easily with bright and dim lighting in a single image. A frame camera on a self-driving car might miss a pedestrian in a shadow beside a well-lit street—with disastrous consequences. An event camera will catch the slightest movement, even in deep shade.

These benefits make event cameras attractive, but they are still fairly new and unknown. The first commercial examples, which appeared in 2014, had a resolution of just 100x100 pixels. Versions branded as “high resolution” appeared in 2019, but all things are relative. The 640x480 pixel resolution of these machines matches that of Apple’s QuickTake camera of 1994. Something closer to real high resolution may be coming soon, though. Both Samsung and Sony are working on event cameras for the mass market. Sony’s will have a recording field measuring 1,280x720 pixels.

Military establishments are interested, too. America’s army, air force and space force all have event-camera projects. They are especially attracted to infrared versions. These would help identify targets rapidly by looking at their heat signatures. Besides having superior movement-detecting abilities, event cameras need less processing power, so generate less signal-confusing heat. This is an even bigger advantage for cameras that are cooled by liquid nitrogen, to increase their sensitivity.

Looking further ahead, both Dr de Croon and some of the military researchers are linking event cameras to “neuromorphic” processing units (computer processors supposedly built in imitation of the ways that brains work). Like event cameras—and unlike conventional computer processors, which are governed by the tick of an internal clock—neuromorphic processors are asynchronous. Combining the two seems to work well, and to promise fast, low-power visual processing.

Event cameras could thus be important elements of an automated future, guiding drones that deliver goods, helping to pilot cars (wheeled or flying) that carry people around, and giving vision to robots in homes and on streets. They may not be much cop for selfies. But they might still be wildly successful. ■



摄影

一种新型相机

它或许对机器人、无人机及无人驾驶汽车价值非凡

传统相机将光线聚焦到记录媒介上，以大量小点的形式留存一张图像。多年来，所用媒介从银板变为玻璃板，又换成醋酸盐胶片，再变为电荷耦合器件。同时，这些小点也从化学颗粒变成了电子像素。但原理保持不变。而动态影像不过是依次显示一连串图像。

这样的装置称为框幅照相机。不过现在有了另一种选择：事件相机。不同于框幅相机，事件相机不使用实体或虚拟快门来同时激活这些小点。相反，一个点只有在入射光的性质改变时才会响应。

由于光线变化经常是运动所致，所以事件相机通常记录事件而非物体——它们也由此得名。虽然它们记录的数据在有需要时也可用于重构物体的图像（见图片），但它们还有其他更好的用途，特别是在相机本身处于运动状态时。

例如，事件相机的独特构造提供了一种迅捷的方法来确定物体在其视野中的移动速度——术语称为“光流”。光流显示相机的移动速度，也显示相机与其他事物间的距离，因为近处的物体在其视野中的位置变化快于远处的物体。

在自然界中也有优化工具以记录光流的例子，那就是昆虫的眼睛。这就是为什么家蝇会如此擅长判断速度与高度——以及正在接近的苍蝇拍有多近。荷兰代尔夫特理工大学（Delft University of Technology）的吉多·德克鲁恩（Guido de Croon）及其同事效仿昆虫，在无人机上使用事件相机判断着陆速度。这让无人机的受控着陆速度比使用框幅相机时更快。

| 事件相机，未来之子

一台每秒拍摄20幅图像的框幅相机以50毫秒的间隔提供数据。事件相机不

受这种固定时间表的限制，可以在微秒内做出反应。和德克鲁恩一样，苏黎世大学机器人与感知小组（Robotics and Perception Group）的负责人达维德·斯卡拉穆扎（Davide Scaramuzza）一直在研究安装在无人机上的事件相机。防撞摄像头通常需要50到200毫秒的反应时间。他的团队使用事件相机将这个时间缩短至不到4毫秒，这样就能在避障的时候实现更快的机动性。

反应时间对于无人驾驶汽车同样重要。斯卡拉穆扎的团队正在与他口中汽车行业里的一家“顶级”公司合作研究事件相机在该领域的应用。

事件相机的优势不只是速度。基于帧幅的摄像机会记录下冗余信息，比如没变化的蓝天。为避免浪费磁盘空间和带宽，以这种方式拍摄的图像经常会用MPEG等特殊软件压缩，便于存储或传输。但事件相机拍摄的照片无需压缩。据斯卡拉穆扎说，事件相机在这方面的效率约为帧幅相机的40倍。

此外，事件相机几乎对“运动模糊”免疫。拍摄高速飞行的子弹不成问题，还能以同等清晰度同时拍摄兔子与乌龟。这样便能解决从闭路电视视频流中提取不模糊的定格画面这个千古难题。

事件相机还有一个优势：可以轻松应对同一张图像中的光线明暗。无人驾驶汽车上的帧幅相机可能会识别不出光线充足的街道旁阴影中的行人——这会导致灾难性的后果。事件相机则会捕捉到最细微的运动，即使它发生在非常暗的阴影中。

这些优点让事件相机颇具吸引力，但它们仍比较新奇，鲜为人知。首批商用产品于2014年出现，分辨率仅为100x100像素。2019年，标榜“高分辨率”的相机出现，但所有事情都是相对的——这些640x480像素分辨率的相机与苹果在1994年的QuickTake相机旗鼓相当。不过，更接近真正高分辨率的设备也许很快就会出现。三星和索尼都在研究面向大众市场的事件相机。索尼的相机将有一个1280x720像素的记录视野。

军事机构也很感兴趣。美国的陆军、空军和太空部队都有事件相机研发项

目。他们对红外事件相机尤其感兴趣。这种相机将有助于通过观察热量特征迅速识别目标。除了具有超强的运动探测能力外，事件相机需要的处理能力更少，产生的会干扰信号的热量也就更少。对于需要使用液氮冷却来提高灵敏度的相机而言，这是个更大的优点。

至于对未来的展望，德克鲁恩和一些军方研究人员都在把事件相机与“神经形态”处理单元（据称是模仿大脑工作方式而打造的计算机处理器）联系起来。和事件相机相同而和受内部时钟控制的传统计算机处理器不同的是，神经形态处理器是异步的。将二者相结合似乎效果不错，并有望实现快速、低功耗的视觉处理。

因此，事件相机可能成为自动化未来的重要元素，引导无人机配送货物，辅助驾驶汽车（有轮子的或是会飞的）来运载乘客，并为家用和街道上的机器人提供视觉。它们可能不太适合自拍，但仍可能大获成功。■



Schumpeter

As its sale of Arm collapses, the tide is turning against SoftBank

Does Masa have his trunks on?

FEW COMPANIES are more emblematic of the tech-obsessed, easy-money era of the early 21st century than SoftBank, the Japanese investment conglomerate founded and run by Son Masayoshi, or Masa for short. Starting life as an obscure Japanese software distributor in 1981, it has made one debt-fuelled bet after another to become an internet firm, a telecommunications giant, and then what Mr Son last year called the world's biggest venture-capital (VC) provider, comfortably ahead of Tiger Global, a New York hedge fund, and Sequoia Capital, a VC powerhouse. Parts of its balance-sheet are opaque yet it continues to borrow heavily and is one of the world's most-indebted non-financial firms. Like many of the Silicon Valley firms it invests in, it has a dominant founding shareholder who is not averse to spouting gobbledygook. Mr Son says he invests with a 300-year horizon, making SoftBank as close to immortal as financial firms get. But it is the here and now that he should be most concerned with.

That is because the tech boom, which SoftBank has both fuelled and benefited from, may be coming to an end. In the face of the highest rates of inflation in decades, central banks have started to raise interest rates. That threatens to tighten credit markets for highly leveraged entities like SoftBank. More important, higher rates make a big difference to the long-term value of the sort of high-growth tech startups it invests in, whose profits are in the distant future. As one of the highest rollers in two of the business megatrends of the past few decades, it is worth asking what would happen if tech fandom and easy money prove evanescent. As Warren Buffett once said, it's only when the tide goes out that you can see who is swimming naked. What, Schumpeter wonders, is the state of Mr Son's

bathing attire?

Mr Son, like Mr Buffett, enjoys a colourful turn of phrase. On Feb 8th, reporting an 87% year-on-year slump in SoftBank's net profit in the nine months to December, he was blunt. Not only was the company in the midst of a blizzard that started last autumn, he said. The storm had got worse in America and elsewhere because of the threat of rising rates. Though SoftBank eked out a small profit in the most recent quarter, the two most important variables that Mr Son watches like a hawk deteriorated sharply. One was the net value of SoftBank's portfolio of assets, which fell by \$19bn to \$168bn. The other was the value of its net debt relative to equity, which reached the highest level since 2018 when SoftBank floated its Japanese telecoms business.

To gauge the risks, start with the asset side of those calculations. However much of a brave face Mr Son puts on it, good news is scant. On the day of its results SoftBank confirmed that it had called off the sale of its British chip business, Arm, to Nvidia, a California-based semiconductor firm, because of regulatory pressure. At Nvidia's highest price, the implied sale value was above \$60bn, or about twice what SoftBank paid for Arm in 2016. Instead SoftBank will sell shares in Arm in an initial public offering (IPO) in the next financial year. Mr Son noted that the underlying profits of Arm's chip business are estimated to have improved recently, which may make it more attractive. Yet Kirk Boodry of Redex Research, an investment adviser, reckons an IPO has little chance of generating as much value as a sale. Moreover, potential investors need only look at the poor public-market performance of almost all the 25 companies SoftBank listed in the past ten months to know that tech IPOs are no longer a gravy train.

Also on the asset side are SoftBank's troubled investments in China and in its two Vision Funds, which invested in a whopping 239 young companies last year. Alibaba, the embattled Chinese tech giant, was once the

cornerstone of SoftBank's investment strategy, accounting for 60% of net assets. Now SoftBank treats it like a get-out-of-jail-free card, selling stakes to fund riskier ventures elsewhere. Its weight in the portfolio has shrunk to 24%. On February 7th Alibaba's share price fell by 6% on fears that SoftBank would cut its stake yet more. For SoftBank, Alibaba is now vastly eclipsed in importance by its two Vision Funds, which account for almost half of the group's net assets. These inched up in value in the most recent quarter, mostly because of valuation gains in unlisted firms. If the stark sell-off of SoftBank's publicly traded firms is any guide, however, it may be only a matter of time before valuations of firms in the pre- IPO stage stagnate or even in some cases start to slide.

SoftBank's debt is worrying, too. It said its loan-to-value (LTV) ratio, or net debt as a share of the equity value of its holdings, was 22% at the end of December, up from 19% three months earlier; it considers 25% to be reasonable in normal times. However, others calculate the ratio more conservatively, including additional liabilities such as margin loans, investment commitments and share buybacks that SoftBank excludes. Sharon Chen of Bloomberg Intelligence, a financial-analysis firm, says that based on her measurements, SoftBank is getting close to the 40% LTV threshold that S&P Global, a ratings agency, has said could be a trigger for a debt downgrade (though the plan to list Arm could ease the pressure). A further sale of Alibaba shares could be used to cut debt, but might also lower the quality of the portfolio—another rating-agency red flag.

| *Wetsuit, speedos or nothing at all?*

SoftBank has had enough debt-related troubles in the past for Mr Son to realise the dangers. It has long pledged to keep enough liquidity on hand to fund two years of debt payments. It also benefits from a pool of banks and ordinary savers in Japan who like the high yields it provides compared with other Japanese borrowers. But its longer-term financial stability rests on

two variables—the value of its assets and the size of its debts—which in current circumstances would benefit more from prudence than growth. More than a pair of speedos, Mr Son needs a wetsuit. ■



熊彼特

出售安谋破局，软银迎来潮退

孙正义在裸泳吗？

在沉迷科技、资金便宜的21世纪初期，没有几家公司比软银更具时代象征意义。这家日本投资企业集团由孙正义创立和执掌，在1981年诞生之初不过是日本一家名不见经传的软件分销商。它通过一次次举债押注的投资成为一家互联网公司、电信巨头，到去年又成为了孙正义口中世界最大的风险投资机构，轻松超越纽约对冲基金老虎环球（Tiger Global）和风投巨擘红杉资本（Sequoia Capital）。软银的资产负债表并不完全透明，但仍在大量举债，是世界上负债最高的非金融企业之一。正如它投资的许多硅谷公司一样，软银有一位创始股东稳操大局，而且喜欢高谈阔论。孙正义声称他的投资放眼未来300年，让软银能像金融企业一样近乎长青永续。但当下才是他最应该担心的。

这是因为软银参与推动并从中受益的科技热潮可能即将退去。面对几十年来最高的通胀数字，各国央行已经开始加息。软银这样的高杠杆企业可能面临信贷市场收紧的威胁。更重要的是，它投资的高成长性科技创业公司要在遥远的未来才能盈利，而利率上升会对它们的长期价值产生巨大的影响。作为在过去几十年的其中两股商业大潮中押下最高赌注的豪客之一，有必要问一问，如果科技狂热和廉价资金烟消云散会怎样？正如巴菲特所言，只有当潮水退去才知道谁在裸泳。熊彼特也想知道，孙正义在水下可还有蔽体之物？

和巴菲特一样，孙正义也喜欢生动的措辞。2月8日，软银公布截止到12月的九个月里净利润同比下降87%。他直言不讳地说，公司不仅身陷始于去年秋季的暴风雪中，而且由于加息的威胁，这场风暴在美国和其他地方愈演愈烈。尽管软银在最近一个季度勉强实现了小幅盈利，但孙正义紧紧盯着的两个最关键指标急剧恶化。一个是软银的投资组合净值，缩减190亿美元，至1680亿美元。另一个是净资产负债率，攀升到了2018年软银日本电信业务上市以来的最高水平。

要评估风险，首先来看看上述指标中的资产状况。无论孙正义表面上多么若无其事，好消息还是寥寥。在发布业绩数字的当天，软银证实，它在监管压力之下已经放弃了将旗下英国芯片公司安谋（Arm）出售给加州半导体公司英伟达（Nvidia）的计划。以英伟达给出的最高收购价计算，售价原本将超过600亿美元，约为软银2016年收购安谋时的两倍。软银转而准备在下一财年通过IPO出售安谋的股份。孙正义指出，近期安谋芯片业务的基本利润预计已有改善，可能会让它更具吸引力。然而，投资顾问公司Redex Research的柯克·布德里（Kirk Boodry）认为，IPO几无可能实现与出售同等的价值。此外，潜在投资者只需看看软银过去10个月里上市的25家公司在公开市场上几乎全都很糟糕的表现，就知道科技公司IPO已经不再是轻松赚大钱的机会了。

在资产这一面，软银在中国和两只愿景基金上的诸多投资也是问题多多，去年这两只基金投资了多达239家年轻公司。面临困局的中国科技巨头阿里巴巴曾是软银投资战略的基石，占其净资产的60%。现在，软银将它用作一张拿来脱困的牌，出售其持股来为自己在其他地区风险更高的项目融资。阿里巴巴在其投资组合中的比重已缩水至24%。2月7日，由于市场担心软银进一步减持，阿里巴巴的股价下跌了6%。对软银而言，阿里巴巴的重要性如今已经远不如它的两只愿景基金，后者已占集团净资产的近一半。这些基金的价值在最近一个季度小幅上升，主要得益于其中非上市公司的估值增长。然而，从软银大幅抛售上市公司股票的行为看来，这些上市前公司的估值停滞不前恐怕只是时间问题，甚至在某些情况下会开始下滑。

软银的负债也令人担忧。该公司表示，截至12月底，其贷款价值比（LTV，即净债务占其所持资产权益价值的比例）为22%，高于三个月前的19%；公司认为在正常时期25%是合理水平。但其他人对该比例的计算更加保守，将软银未纳入的保证金贷款、投资承诺和股票回购等其他负债也统计在内。金融分析公司彭博行业研究（Bloomberg Intelligence）的莎伦·陈（Sharon Chen）表示，根据她的测算，软银的LTV已经接近标普全球（S&P Global）设定的40%的阈值，该评级机构曾表示这一水平可能导致债务降级（不过安谋的上市计划可能缓解这方面的压力）。公司可以出

售更多阿里巴巴股票来削减债务，但投资组合的质量也可能因此而降低——这是评级机构关注的另一个危险信号。

| 潜水服，泳裤，还是裸泳？

软银经历过太多债务方面的麻烦，孙正义自然对这种危险有充分认识。长期以来，这家公司一直承诺会持有足够的流动资金，足以应付未来两年的偿债支出。它也受益于一批日本银行和普通储户的青睞，因为软银提供的收益高于其他日本借款方。但更长期的财务稳定性取决于两个变量——资产价值和债务规模——在当前情况下，谨慎比扩张更有利于这些指标的健康度。一条泳裤恐怕并不足够，孙正义需要的是一套潜水服。 ■



Billionaires and inequality

“Davos Man” is a passionate denunciation of the mega-rich

But Peter Goodman overstates his case

Davos Man: How the Billionaires Devoured the World. By Peter Goodman.
Custom House; 480 pages; \$29.99 and £20

IN JANUARY 2021 Marc Benioff, the billionaire founder of Salesforce, a software firm, delivered his verdict on the pandemic’s first year. “We have to say it,” he declared to those observing the virtual proceedings of the World Economic Forum (WEF), an annual gathering of the elite in Davos, Switzerland: “CEOs are definitely the heroes of 2020.”

The grandest of them were certainly among its winners. In that year, as millions of people died of covid-19 and many more faced severe hardship, the collective wealth of the world’s billionaires rose by \$3.9trn, reports Peter Goodman, global economics correspondent for the New York Times, in his new book. The incongruity of the fortunes of the rich soaring amid mass suffering is no accident, he reckons. Despite fervent claims to the contrary by the mega-rich, Mr Goodman says, their pursuit of wealth has undermined society’s capacity to deal with crises and left the world in its present troubled state.

Mr Goodman is a veteran journalist who has covered economics for several papers and from postings around the globe. “Davos Man” is well-written and well-reported, and dedicated to exposing the falsity of what he calls the “Cosmic Lie”—the notion that what helps the rich become richer benefits everyone. To discredit it, Mr Goodman juxtaposes the view from the luxury stomping grounds of the billionaire class with vignettes from working-class neighbourhoods—pairing a yacht-riding titan of fast fashion with a jobless textile worker, the spacefaring Jeff Bezos with an overworked

Amazon package-picker.

He focuses on a handful of representative billionaires such as Mr Bezos and Stephen Schwarzman, the co-founder and CEO of Blackstone, a private-equity firm, towards whom the author appears to harbour a particular animus. He serves up juicy quotes capturing Mr Schwarzman's unrepentant glee at the financial opportunities created by the pandemic ("There's always a way of making money in these types of volatile situations"). The author also documents the way some private-equity firms piled into the health-care sector—and slashed hospital capacity—in the years before the advent of covid-19.

The text vibrates with anger. The sense of outrage that radiates from the page is initially off-putting, but becomes ever easier to share over the course of the book. It is stoked not only, or even primarily, by the ways the plutocrats build their fortunes. Mr Goodman's disgust is spurred more by gymnastic feats of tax avoidance, the occasionally staggering lack of empathy and self-awareness, and the towering injustice of extreme wealth alongside terrible adversity. Thus the spleen vented at the WEF, which in Mr Goodman's description functions like billionaire therapy: a place where the very rich go to reassure themselves that they are the solution to social ills rather than the problem.

But the book is not altogether persuasive. Its arguments are weakened by a determination to pin most of the world's ills on the mega-rich. Private-equity barons may be responsible for turfing longtime tenants out of properties in order to flip them and turn a profit, but not for the high cost of housing generally, which has far more to do with middle-class homeowners' success in limiting dense development. Neither is immense wealth necessarily a product of tax-dodging and rent-seeking. Mr Bezos, for example, would not be a billionaire if millions of consumers were not so keen to shop with Amazon.

Indeed, “Davos Man” itself shows that there is plenty of blame to go around. Mr Goodman documents how xenophobia and racism flourish in places left behind by economic change, and how the charges often levelled at refugees and immigrants—that they are troublesome freeloaders—are baseless. But he sees nativism as another black mark against billionaires, rather than an ethical failure by people who may have suffered, but have not lost their capacity for moral reasoning. Similarly, he quotes a cab driver from Sunderland, in northern England, who admits of Brexit: “No one here really understood [it]...We just knew that people in London had been fucking us for as long as we could remember...It was our chance to fuck them back.”

The reckless use of individuals’ civic rights, as much as the sins of the billionaires, has landed some countries in dire straits. Mr Goodman ends by arguing that a better world is possible through the “thoughtful use” of democracy. It is, but only if voters are more interested in taking responsibility for improving their lot than in searching for scapegoats. ■



亿万富豪与不平等

《达沃斯人》痛斥超级富豪

但彼得·古德曼话说重了【《达沃斯人》书评】

《达沃斯人：亿万富豪如何吞噬世界》，彼得·古德曼著。Custom House出版社；480页；29.99美元/20英镑。

去年1月，软件公司Salesforce的创始人、亿万富豪马克·贝尼奥夫（Marc Benioff）发表了他对新冠疫情第一年的结论。“必须得说，”他向那些观看世界经济论坛（精英们在瑞士达沃斯的年度聚会）线上会议的人宣告，“CEO们绝对是2020年的英雄。”

CEO中最显赫的那些人无疑在2020年的赢家之列。这一年数百万人死于新冠肺炎，还有多得更多的人面对严重困境，而全球亿万富豪的总财富增加了3.9万亿美元，《纽约时报》全球经济记者彼得·古德曼（Peter Goodman）在自己的新书中写道。他认为，大众饱受困苦，而富人财富暴涨，这样的反差并非偶然。古德曼表示，尽管超级富豪们急切地提出了相反的说法，但他们对财富的追求削弱了社会应对危机的能力，让全球陷入了眼下的困境。

古德曼是资深记者，曾为多家报纸撰写经济报道，驻全球各地采编发文。《达沃斯人》（Davos Man）写作上乘，报道详实，全力揭露他称之为“弥天大谎”的虚假说法——即帮富人变得更富对每个人都有好处。为了揭穿它，古德曼将亿万富豪阶层的奢侈生活与工人阶级社区的场景放在一起相对照——乘坐游艇的快时尚界巨头和失业的纺织工人；去太空旅行的贝索斯与超负荷工作的亚马逊包裹分拣工。

他聚焦于几个有代表性的亿万富豪，比如贝索斯和私募股权公司黑石集团的联合创始人兼首席执行官苏世民（Stephen Schwarzman）。作者似乎尤其憎恶这些人。他奉上了一些生动的引述，充分体现苏世民对疫情创造的金融机遇恬不知耻的窃喜（“在这样不太平的世道，总有赚钱的法

子”）。作者还记录了疫情之前的几年里一些私募股权公司如何扎堆涌入医疗行业——并大幅削减了医院资源。

这些文字在怒火中颤栗。一开始，本书字里行间散发出的愤慨令人不快，但读着读着就越来越容易被感染。激起愤怒的原因不仅是富豪们积累财富的方式（这甚至不是一个主要原因）。触发古德曼厌恶情绪的更多是体操技艺般闪转腾挪的避税操作、时不时出现的令人难以置信的缺乏同理心和自知之明，以及极端富有与可怖不幸并存的滔天不公。所以怒火被发泄在了世界经济论坛的头上。在古德曼的描述中，这个论坛就好像是对亿万富豪的心理治疗：他们到那里自我安抚一番，让自己相信他们是社会弊病的解决方案，而不是问题所在。

但这本书不能完全令人信服。它一心要把世界的大部分弊病都归咎于超级富豪，这削弱了它的论证。或许确实是私募股权大亨们赶走了长期租户以将房产转手获利，但高房价并不普遍由他们造成，而是与中产阶级房主成功限制了密集开发有很大关系。巨额财富也未必就是逃税和寻租的结果。比方说，如果数以百万计的消费者不那么热衷在亚马逊购物，贝索斯就成不了亿万富豪。

实际上，《达沃斯人》本身就展示了很多可归咎的因素。古德曼记述了仇外情绪和种族主义如何在被经济变革抛弃的地区盛行，以及针对难民和移民的指控——指责他们是吃白食的麻烦精——是怎样地毫无根据。但他视本土主义为亿万富豪的又一个污点，而不是一些可能遭受了苦难但没有丧失道德推理能力的人的道德失败。同样，他引用了一位来自英格兰北部的桑德兰、赞同英国脱欧的出租车司机的话：“这里没人真正懂（它）……我们只知道，打从我们记事起，伦敦人就一直在欺负我们……这是我们还手的机会。”

对个人公民权利不计后果的滥用，如同亿万富豪的罪过一样，让一些国家陷入水深火热。古德曼在该书的结尾提出，“深思熟虑地运用”民主有可能建设一个更美好的世界。的确如此，但前提是选民更愿意为改善自身境遇承担责任，而不是找替罪羊。■



Drones of their own

Turkey is the arms industry's new upstart

It has won clients in Azerbaijan, Ethiopia, Ukraine and elsewhere

IT HAS LEFT a trail of smouldering Russian-made tanks, trucks and artillery in wars in Nagorno-Karabakh, Syria and Libya. Soon Turkey's TB2 drone may have a chance to do so again in Ukraine, which has bought dozens of them over the past couple of years and is now bracing for a Russian invasion. On February 3rd Ukraine's president, Volodymyr Zelensky, and Turkey's, Recep Tayyip Erdogan, inked a deal to build more of them together. Some of the drones have already seen action. A TB2 destroyed a howitzer used by pro-Russian separatists in Ukraine's Donbas region in October. American officials say Russia may have been planning to fake a TB2 strike against civilians as a pretext for war.

Mr Erdogan sees Turkey's drones as the harbinger of a military revolution. He wants to eliminate Turkey's reliance on foreign suppliers and turn the country into a big arms exporter. Some of his plans are fanciful, but he has already made considerable headway. Next year Turkey expects to deliver two corvettes to Ukraine, of a model used by its own navy.

Turkey's arms industry is bigger and more self-sufficient than ever. Turnover rose from \$1bn in 2002 to \$11bn in 2020. Its army, the second-biggest in NATO, once relied on foreign suppliers for 70% of its needs. That is now down to 30%. Last year Turkish arms and aerospace exports reached \$3.2bn, a new record.

Plans to develop a homegrown defence industry first picked up steam after 1974, when America responded to Turkey's invasion of Cyprus with an arms embargo. But they have kicked into overdrive under Mr Erdogan. Foreign pressure is again a big motivator. After Mr Erdogan purchased a missile-

defence system from Russia in 2017, America banished Turkey from its F-35 stealth-fighter programme and imposed sanctions on the country's procurement agency. Other NATO allies banned some weapons sales after Turkey attacked American-backed Kurdish rebels in Syria and supported Azerbaijan in its recent war with Armenia. Mr Erdogan now seems determined to go it alone. "We will continue," he said last year, "until we completely free our country from foreign dependence."

Turkey's drone programme has been the industry's calling card. (It has also become a family affair. The head of the programme, Selcuk Bayraktar, married one of Mr Erdogan's daughters in 2016.) At only a few million dollars a pop, the TB2s have been flying off the assembly line. Last year Poland became the first NATO member to buy them. Turkey has sold them to at least 12 other countries, including Qatar, Morocco and Ethiopia, which has used them against rebels from Tigray, its northernmost region. Evidence suggests the TB2 was responsible for an air strike that killed at least 58 civilians in Tigray in January. In Turkey's own forever war against the guerrillas of the Kurdistan Workers' Party (PKK) in northern Iraq and Syria, the TB2 has become a routine tool. Mr Erdogan believes total victory is within reach, and rules out new peace talks.

But Turkey's ambitions go well beyond drones. The country plans to roll out its first light aircraft carrier, the 25,000-tonne TCG Anadolu, later this year. The warship was designed with the F-35 in mind but is being refitted to carry the Akinci drone, the TB2's more advanced cousin. The new drone, equipped with a Ukrainian engine, can strike targets in the air and on the ground. Deliveries of Turkey's first indigenous battle tank, the Altay, are scheduled to begin in 2023, though the project has been plagued by delays. Qatar, which owns 49.9% of the company that produces the tanks, has promised to purchase 100 of them. Turkey also plans to build its own submarines, unmanned attack helicopters and fighter jets.

The industry has a bright future, but Mr Erdogan's dream of self-sufficiency is unrealistic. Designing and building components like aircraft and naval engines, advanced sensors and microchips is prohibitively expensive, says Arda Mevlutoglu, a defence analyst. Foreign sanctions, which have inspired the industry's growth, are also holding it back, disrupting procurement and exports. The most notable example is Turkey's planned sale of 30 attack helicopters to Pakistan. The deal, worth \$1.5bn, is nearing collapse because America has refused to grant Turkey an export licence for the chopper's American-made engine.

The biggest hole is the one left behind by the 100 F-35s Turkey ordered, but will not receive. Aboard the TCG Anadolu or elsewhere, Turkey's drones are no substitute for the advanced American fighter jets. Unfortunately for Ukraine, they are also no match for Russia's army. The TB2s could land a few blows in the war's early stages, says Michael Kofman of CNA, an American think-tank, but would easily be knocked out of the sky or destroyed on the ground by Russian air defences and warplanes. Conflicts with Russian proxies allowed Turkey to show off its new weapons. A Russian war with Ukraine would be a vastly tougher test. ■



自有无人机

土耳其成为军火业新贵

它已赢得阿塞拜疆、埃塞俄比亚、乌克兰等买家

在纳戈尔诺-卡拉巴赫、叙利亚和利比亚的战事中，土耳其的TB2攻击无人机一路击毁了不少俄制坦克、卡车和火炮。也许很快它就会有机会在乌克兰重现这一幕。过去几年乌克兰已购入数十架TB2，目前它正在准备应对俄罗斯入侵。2月3日，乌克兰总统泽连斯基和土耳其总统埃尔多安签署了协议，计划合作制造更多TB2。乌克兰购入的TB2中有一些已投入战斗。去年10月，一架TB2摧毁了乌克兰顿巴斯地区亲俄分裂分子使用的一门榴弹炮。美国官员称，俄罗斯可能一直在谋划捏造TB2空袭平民事件，作为开战借口。

埃尔多安把土耳其的这些无人机看作是一场军工业革命的先兆。他希望消除土耳其对外国供应商的依赖，变身为武器出口大国。他的某些计划显得异想天开，但他仍然取得了不小的进展。预计土耳其将在明年向乌克兰交付两艘轻型护卫舰，这是土耳其海军的一个现役型号。

目前土耳其的军火工业在规模和自给能力上都超过以往。交易额从2002年的10亿美元上升到2020年的110亿美元。土耳其军队的规模居北约第二，一度依赖外国军火供应商满足其70%的需求，而现在已下降至30%。去年，土耳其的武器和航空航天装备出口额达到32亿美元，创下新高。

发展本土国防工业的计划在1974年之后首次加速，当时土耳其入侵塞浦路斯，美国随之对土耳其实施武器禁运。而在埃尔多安的领导下，这些计划更是狂飙突进。外国压力再次成为一大推动因素。2017年，埃尔多安从俄罗斯购入导弹防御系统，之后，美国把土耳其踢出了自己的F-35隐形战斗机项目，并对土耳其的采购机构实施制裁。在土耳其攻击美国扶植的叙利亚库尔德叛军及去年支持阿塞拜疆与亚美尼亚作战后，其他北约盟国开始对土耳其禁售部分武器。现在埃尔多安似乎决意自己单干。“我们会继续推进，”他去年说，“直到我国完全摆脱对外国的依赖。”

土耳其的无人机项目成了其军火业的“名片”。（项目负责人塞尔柱克·拜拉克塔尔[Selcuk Bayraktar]在2016年与埃尔多安的一个女儿结婚，这个项目也成了总统的家族事务。）单价仅几百万美元的TB2成了畅销货。去年，波兰成为首个购入TB2的北约成员国。土耳其还向卡塔尔、摩洛哥和埃塞俄比亚等其他至少12个国家出售了这款无人机，其中埃塞俄比亚用它们来对付该国最北部地区提格雷（Tigray）的叛军。有证据表明，1月在提格雷造成至少58名平民死亡的空袭是通过TB2发动的。在土耳其自己与库尔德工人党游击队在伊拉克北部和叙利亚的长期拉锯战中，TB2已成为一种常规武器。埃尔多安认为全面胜利指日可待，拒绝展开新和谈。

但土耳其的抱负远不止于无人机。该国计划在今年早些时候推出第一艘自制轻型航母：排水量25,000吨的TCG阿纳多卢号。该战舰最初的设计是要搭载F-35隐形战斗机，但目前正在改装用以搭载TB2更先进的“表亲”——“游骑兵”无人机（Akinci）。这个新款无人机配备一台乌克兰制发动机，可以攻击空中以及地面目标。土耳其第一款本土生产的主战坦克“阿尔泰”（Altay）计划于2023年开始交付，尽管项目进度再三延误。拥有该坦克制造商49.9%股份的卡塔尔已承诺购买100辆。土耳其还计划制造自己的潜艇、无人驾驶武装直升机和战斗机。

土耳其军火业前景大好，但埃尔多安自给自足的梦想并不现实。设计制造飞机及军舰发动机、先进传感器、微芯片等部件的成本极高，军火业分析师阿尔达·梅伏卢格鲁（Arda Mevlutoglu）指出。曾促发该行业增长的外国制裁也在阻碍它的发展，因为中断了军火的采购和出口。最明显的例子是土耳其计划向巴基斯坦出售30架武装直升机。这笔价值15亿美元的交易现在已接近泡汤，因为美国拒绝向土耳其发放该直升机美制发动机的出口许可证。

土耳其订购的100架F-35隐形战机已被取消，这是制裁留下的最大窟窿。在TCG阿纳多卢号或其他搭载平台上，土耳其的无人机还取代不了美国的先进战机。对乌克兰来说，不幸的是，这些无人机也不是俄罗斯军队的手。美国智库海军分析中心（CNA）的迈克尔·科夫曼（Michael Kofman）说，TB2也许能在战争初期造成一些打击，但很容易被俄罗斯的

防空系统和战机从空中击落或在地面摧毁。与亲俄代理人的冲突使土耳其得以炫耀自己最新的武器。俄罗斯与乌克兰的战争则将是一次严峻得多的考验。 ■



The next crisis

What would happen if financial markets crashed?

Look to history for a guide, but know that next time will be different

“FOR HISTORIANS each event is unique,” wrote Charles Kindleberger in his study of financial crises. But whereas “history is particular; economics is general”—it involves searching for patterns which indicate if a cycle is turning. Today America’s financial system looks nothing like it did before the crashes of 2001 and 2008, yet lately there have been some familiar signs of froth and fear on Wall Street: wild trading days on no real news, sudden price swings and a queasy feeling among many investors that they have overdosed on techno-optimism. Having soared in 2021, shares on Wall Street had their worst January since 2009, falling by 5.3%. The prices of assets favoured by retail investors, like tech stocks, cryptocurrencies and shares in electric-car makers, have plunged. The once-giddy mood on r/wallstreetbets, a forum for digital day-traders, is now mournful.

It is tempting to think that the January sell-off was exactly what was needed, purging the stockmarket of its speculative excesses. But America’s new-look financial system is still loaded with risks. Asset prices are high: the last time shares were so pricey relative to long-run profits was before the slumps of 1929 and 2001, and the extra return for owning risky bonds is near its lowest level for a quarter of a century. Many portfolios have loaded up on “long-duration” assets that yield profits only in the distant future. And central banks are raising interest rates to tame inflation. America’s Federal Reserve is expected to make five quarter-point increases this year. German two-year Bund yields leapt 0.33 points in the first week of this month, their biggest jump since 2008.

The mix of sky-high valuations and rising interest rates could easily result in large losses, as the rate used to discount future income rises. If big losses

do materialise, the important question, for investors, for central bankers and for the world economy, is whether the financial system will safely absorb them or amplify them. The answer is not obvious, for that system has been transformed over the past 15 years by the twin forces of regulation and technological innovation.

New capital rules have pushed a lot of risk-taking out of banks. Digitisation has given computers more decision-making power, created new platforms for owning assets and cut the cost of trading almost to zero. The result is a high-frequency, market-based system with a new cast of players. Share-trading is no longer dominated by pension funds but by automated exchange-traded funds (ETFs) and swarms of retail investors using slick new apps. Borrowers can tap debt funds as well as banks. Credit flows across borders thanks to asset managers such as BlackRock, which buy foreign bonds, not just global lenders such as Citigroup. Markets operate at breakneck speed: the volume of shares traded in America is 3.8 times what it was a decade ago.

Many of these changes have been for the better. They have made it cheaper and easier for all types of investors to deal in a broader range of assets. The crash of 2008-09 showed how dangerous it was to have banks that took deposits from the public exposed to catastrophic losses, which forced governments to bail them out. Today banks are less central to the financial system, better capitalised and hold fewer highly risky assets. More risk-taking is done by funds backed by shareholders or long-term savers who, on paper, are better equipped to absorb losses.

Yet the reinvention of finance has not eliminated hubris. Two dangers stand out. First, some leverage is hidden in shadow banks and investment funds. For example the total borrowings and deposit-like liabilities of hedge funds, property trusts and money market funds have risen to 43% of GDP, from 32% a decade ago. Firms can rack up huge debts without anyone

noticing. Archegos, an obscure family investment office, defaulted last year, imposing \$10bn of losses on its lenders. If asset prices fall, other blow-ups could follow, accelerating the correction.

The second danger is that, although the new system is more decentralised, it still relies on transactions being channelled through a few nodes that could be overwhelmed by volatility. ETFs, with \$10trn of assets, rely on a few small market-making firms to ensure that the price of funds accurately tracks the underlying assets they own. Trillions of dollars of derivatives contracts are routed through five American clearing houses. Many transactions are executed by a new breed of middle men, such as Citadel Securities. The Treasury market now depends on automated high-frequency trading firms to function.

All these firms or institutions hold safety buffers and most can demand further collateral or “margin” to protect themselves from their users’ losses. Yet recent experience suggests reasons for concern. In January 2021 frenzied trading in a single stock, GameStop, led to chaos, prompting large margin calls from the settlement system, which a new generation of app-based brokerage firms, including Robinhood, struggled to pay. The Treasury and money markets, meanwhile, seized up in 2014, 2019 and 2020. The market-based financial system is hyper active most of the time; in times of stress whole areas of trading activity can dry up. That can fuel panic.

Ordinary citizens may not think it matters much if a bunch of day-traders and fund managers get burned. But such a fire could damage the rest of the economy. Fully 53% of American households own shares (up from 37% in 1992), and there are over 100m online brokerage accounts. If credit markets gum up, households and firms will struggle to borrow. That is why, at the start of the pandemic, the Fed acted as a “market-maker of last resort”, promising up to \$3trn to support a range of debt markets and to backstop dealers and some mutual funds.

| *Fine margins*

Was that bail-out a one-off caused by an exceptional event, or a sign of things to come? Ever since 2008-09 central banks and regulators have had two unspoken goals: to normalise interest rates and to stop using public money to underwrite private risk-taking. It seems that those goals are in tension: the Fed must raise rates, yet that could trigger instability. The financial system is in better shape than in 2008 when the reckless gamblers at Bear Stearns and Lehman Brothers brought the world to a standstill. Make no mistake, though: it faces a stern test. ■



【首文】下一次危机

如果金融市场崩溃会如何？

以史为鉴。但要明白历史不会简单重复

“在历史学家眼中，每一起事件都是独一无二的。”美国经济史学家查尔斯·金德尔伯格（Charles Kindleberger）在对金融危机的研究中写道。但是，“历史事件是独特的，经济学却探求共性”——这门学问探寻那些显示存在周期运行的规律。今天，美国的金融体系与2001年和2008年危机爆发前的状态似乎毫无相似之处，但最近华尔街出现了一些似曾相识的泡沫和恐惧的迹象：明明没什么实质性新闻却出现了疯狂交易日；股价骤起骤落；许多投资者惴惴不安，怀疑自己在科技乐观主义中嗨过了头。华尔街股市在2021年飙升后迎来了2009年以来最差的1月，下跌了5.3%。科技股、加密货币和电动汽车制造商股票等散户投资者青睐的资产价格暴跌。在日内交易者论坛r/wallstreetbets上，曾经狂热的气氛如今已变为一片悲戚。

你可能会倾向于认为1月的抛售正是市场所需要的，因为它去除了股市中投机过度的部分。但实际上美国看似焕然一新的金融体系仍然充满风险。资产价格处于高位：股价与长期利润之比如此之高，之前出现同样情况还是在1929年大萧条和2001年的经济衰退前夕，而持有高风险债券的超额回报已跌至近25年来的最低水平。许多投资组合大量买入“长期”资产，它们在很远的未来才会产生利润。各国央行纷纷加息来抑制通胀。预计美联储今年会做五次25个基点的加息。德国两年期国债收益率在本月第一周跃升33个基点，是2008年以来的最大升幅。

天价估值加上利率上升很可能导致严重损失，因为未来收入的折现率提高了。假如巨大亏损真的发生，对投资者、央行官员和世界经济来说，关键的问题就是美国的金融体系是能安全地吸收损失还是会放大损失。答案并非一目了然，因为在过去15年里，这个体系已被监管和技术创新两方面的力量所改变。

新的资本规则大大减少了银行承担的风险。数字化赋予计算机更多决策权，创造了购入资产的新平台，把交易成本削减至近乎零。由此形成了一个高频、基于市场且拥有一批全新玩家的体系。股票交易不再由养老基金主导，取而代之的是自动化的交易所交易基金（ETF）以及大批通过新颖的智能应用买卖的散户投资者。除了向银行借款，人们还可以利用债务基金获取信贷。信贷跨国流动不只靠花旗集团等全球性银行，也有赖于贝莱德（BlackRock）等购买外国债券的资产管理公司。市场以惊人高速运转：美国的股票交易量是十年前的3.8倍。

这些变化有许多是好事。所有类型的投资者现在都能以更低廉的费用更方便地交易更广泛的资产。2008年至2009年的金融危机已经显示出，如果接收公众存款的银行出现灾难性损失会酿成多么危险的局面，迫使政府出手救助。现在，银行在金融体系中不再那么举足轻重，它们资本更充裕，持有的高风险资产也减少了。承担更多风险的是由股东或长期储户支持的基金，理论上他们更有能力承受损失。

然而，金融业的这番重塑并没有清除狂妄的心态。两大风险突显出来。首先，一些杠杆隐藏在影子银行和投资基金里。例如，对冲基金、房地产信托和货币市场基金的总借款和存款类负债已从十年前相当于GDP的32%上升至43%。企业可能累积起巨额债务而完全不被察觉。名不见经传的家族投资办公室Archegos去年违约，给贷款机构造成100亿美元的损失。假如资产价格下跌，其他爆雷事件也可能会接续发生，加速市场修正。

第二个风险是，尽管新体系的去中心化程度更高，但交易仍要通过少数节点进行，而它们可能经不起市场波动的冲击。资产规模达十万亿美元的ETF依靠少数小型做市商来确保基金价格准确追踪所持有的标的资产。数万亿美元的衍生品合约通过五家美国清算所执行。许多交易由城堡证券（Citadel Securities）这类新型中间商执行。美国国债市场现在依赖自动化高频交易公司运作。

所有这些公司或机构都配备有安全缓冲，而且大多可以要求追加抵押品或“保证金”来保护自己免受用户损失的影响。但近年的经验显示有理由感到

担心。2021年1月，对美国游戏零售商游戏驿站（GameStop）这一只股票的疯狂交易导致市场混乱，触发结算系统大幅追缴保证金，让包括罗宾汉（Robinhood）在内的基于应用的新一代券商无力应付。与此同时，美国国债和货币市场在2014年、2019年和2020年均出现过失灵。这个基于市场的金融体系在大多数时候非常活跃，但在压力加大时，整个领域的交易活动可能会枯竭。而这可能引发恐慌。

一群日内交易者和基金经理引火烧身，普通人可能会觉得没什么要紧。但这把火可能波及其他经济领域。现在足足有53%的美国家庭持有股票（1992年时为37%），在线券商开户数已超过一亿。假如信贷市场失灵，家庭和公司将难以借到钱。这就是为什么在疫情爆发之初，美联储充当了“最后的做市商”，承诺最高投入三万亿美元，支持一系列债务市场、交易商和部分共同基金。

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美联储那次救市是由特殊事件引发的一次性措施，还是预示未来行动的信号？自2008年至2009年金融危机以来，央行和监管机构定下了两个心照不宣的目标：利率正常化；停止用公共资金为私人冒险行为做担保。现在这些目标似乎开始相互拉锯：美联储必须加息，而这可能引发市场不稳。2008年，贝尔斯登和雷曼兄弟的鲁莽赌徒把世界经济拽入了停滞状态。美国金融体系的现状要好于那时。但毋庸置疑，它眼下同样面临严峻的考验。 ■



The hills are alive

China's ski industry faces an avalanche of risks

Developers have ploughed mountains of money into the snow business. Will it melt away?

IN MUCH OF the world the business of running ski slopes has, like most of tourism, been crippled by lockdowns and travel restrictions. China is no exception. Visits to Chinese ski areas slumped by 38% in 2020—steeper than a global decline of 14% after covid-19 hit. Two in five winter-sports businesses lost more than half their revenue as a result of anti-virus measures, according to the Beijing Olympic City Development Association, an official group set up to champion sport. One in 14 ski areas, especially small ones, gave up the ghost in 2020. As China prepared to host the Winter Olympics, which opened in Beijing on February 4th, its ski-industrial complex was hoping that this celebration of all pursuits below freezing would mark the end of a short-lived icy patch.

Unlike Europe and America, where the winter-sports sector's downhill slide predates the pandemic, Chinese skiers were taking to the slopes in record numbers. The Beijing Ski Association says that people paid more than 20m visits to China's ski venues in 2019, twice as many as in 2014. Eileen Gu, a teenager raised in San Francisco who has chosen to represent China, where her mother was born, in freestyle skiing, has recalled that just a few years ago she knew virtually all the freestyle skiers in the country. Now the gold-medal contender suggests they are like snowflakes in a blizzard.

Investors have been swept up, too. China had nearly 800 ski areas before the pandemic, four times the number in 2008 and not a world away from around 1,100 in the Alps, where they began popping up around 1900. Though the Chinese areas still have many fewer lifts than Western ones,

they are getting more sophisticated. Some now offer summer pastimes like mountain-biking, hiking and rafting. China's 36 indoor ski centres—it has more of these than any other country—accounted for a fifth of all ski visits in the country in 2020. Sunac China is the world's largest operator of such venues. Indoor ski slopes contributed to the success of the developer's culture-and-tourism business (which also includes malls, water-sports venues and hotels), where revenues grew by 166% year on year in the first half of 2021.

Even so, Chinese ski-resort operators are vulnerable to two industry-wide uncertainties. The first is climate change. Since milder temperatures mean less snow, ski resorts everywhere are hostage to global warming. Doubts over sufficient snowfall have prompted Olympic organisers this year to rely entirely on artificial snow for the first time. But making the white stuff artificially uses an awful lot of water—a scarce resource in China's drought-prone north, home to half its population and most of its resorts. The Olympic games alone may need 2m cubic metres—enough to fill 800 Olympic-size swimming pools—to produce sufficient snow cover, according to Carmen de Jong, a hydrologist at the University of Strasbourg. Officials reckon the event will use up to a tenth of all water consumed during the ski events in the Chongli district, which will host them. Indoor slopes, for their part, need less snow but all of it is artificial.

The second uncertainty has to do with future demand. China still has room to catch up with big skiing nations. Chinese skiers hit the slopes once a year in the winter of 2020-21, on average, compared with half a dozen times for those in Austria or Switzerland. Optimists also point out that many Chinese skiers are young, and so in principle have plenty of skiing left in their legs; whereas in America more than one-fifth of skiers are over 55, about 80% of China's are under 40 years old, according to Laurent Vanat, a consultant on the global ski industry.

However, precisely because China lacks a strong tradition of skiing, absolute beginners are exceptionally common on its pistes. Around 80% of skiers in China are first-timers this season, up from 72% in 2019, according to Mr Vanat. In Europe and America the share is less than 20%. China's ski industry is counting on a strong showing from Ms Gu and the rest of the national team to convert such neophytes into regulars. Like her, though, resort owners face tough terrain ahead. ■



群山舞动

中国的滑雪产业面对“风险雪崩”

开发商将大堆资金投入冰雪生意。这些钱会不会如雪花般消融？

和大部分旅游业务一样，世界各地的众多滑雪场都因为封锁措施和旅行限制而陷入冷寂。中国也不例外。2020年，中国滑雪场的访客剧减38%，比新冠疫情爆发后全球14%的降幅还大。根据致力于推动体育事业的官方团体“北京奥运城市发展促进会”的数据，由于各种防疫措施，五分之二冬季运动企业损失了逾一半的收入。2020年，每14个滑雪场中就有一个关门大吉，尤其是小滑雪场。先前中国筹备2月4日在北京开幕的冬季奥运会之际，中国的滑雪产业希望这场各式冰雪项目轮番登场的庆典将终结一个短暂的冰冻期。

在欧洲和美国，冬季运动产业在疫情爆发前就已经在走下坡路，而中国不同，疫情前踏上雪道的滑雪者人数创下了记录。北京滑雪协会表示，2019年中国滑雪场馆接待游客超过2000万人次，是2014年的两倍。在旧金山长大的少女谷爱凌选择代表她母亲的出生地中国参加自由式滑雪比赛。她回忆说，就在几年前，她几乎认识中国每一个自由式滑雪运动员。而现在，这位金牌争夺者表示，他们像暴风雪中的雪花一样多不胜数。

投资者也被吸引了过来。疫情爆发前中国有近800个滑雪场，是2008年的四倍，与在1900年前后就开始有滑雪场的阿尔卑斯山地区的现有数目（1100个左右）相差不多。尽管中国雪场的缆车数量比西方少得多，但他们的服务项目越来越复杂。有些滑雪场现在提供如山地骑行、徒步和漂流等夏季消遣活动。中国有36个室内滑雪中心，比其他任何国家都多，接待人次占到2020年中国滑雪总人次的五分之一。融创中国是全球最大的室内滑雪场运营商，室内滑雪场促成了这家房地产开发商旗下的文化旅游业务（其中还包括购物中心、水上运动场馆和酒店）的成功，2021年上半年这一块业务的收入同比增长了166%。

即便如此，中国滑雪场运营商仍然容易受到两个笼罩全行业的不确定因素

的影响。首先是气候变化。温度升高意味着雪量减少，各大滑雪胜地都受制于全球变暖。因为担心降雪量不足，奥组委今年首次完全依靠人工造雪。但是，人工造雪要消耗大量的水——这在中国干旱频发的北方是种稀缺的资源，而中国一半的人口和大部分滑雪场都在北方。斯特拉斯堡大学（University of Strasbourg）的水文学家卡门·德容（Carmen de Jong）表示，仅这一届奥运会可能就需要200万立方米的水来造出足够的积雪，这些水足以填满800个奥运会标准游泳池。官员们估计，在举行滑雪项目的崇礼，比赛期间的造雪用水最多会占到该地区总用水量的十分之一。室内滑雪场相对来说需要的雪较少，但所有的雪都是人造的。

第二个不确定性与未来需求有关。中国距离那些滑雪大国还有追赶空间。2020年底至2021年初的冬季，中国滑雪者平均每年上一次雪场，而奥地利或瑞士的滑雪者平均上六次。乐观者还指出，中国许多滑雪者都很年轻，所以理论上他们还能滑很多年；美国超过五分之一的滑雪者年龄在55岁以上，而中国大约80%的滑雪者在40岁以下，全球滑雪产业顾问劳伦特·凡奈特（Laurent Vanat）说。

不过，正是因为中国没有深厚的滑雪传统，纯初学者在中国的雪道上格外常见。据凡奈特称，这个雪季中国约有80%的滑雪者是第一次滑雪，比2019年的72%有所上升。在欧洲和美国，这一比例不到20%。中国的滑雪行业正指望谷爱凌和国家队其他成员的强劲表现能把这些新手变成常客。不过，和她一样，滑雪场老板们的前面也是一条险峻的赛道。■



The urge to splurge

Why the impressive pace of investment growth looks likely to endure

Supply chains, technological change and climate targets will all demand more capital spending in the 2020s

FOR YEARS after the global financial crisis the world economy was starved of investment. The aftermath of the covid-19 downturn has been drastically different. In America private non-residential investment is only about 5% below its pre-pandemic trend, compared with a shortfall of nearly 25% in mid-2010, the equivalent point in the previous economic cycle (see chart). The country has enjoyed the fastest rebound in business investment in any recovery since the 1940s, according to Morgan Stanley, a bank. In the rich world as a whole, predicts the World Bank, total investment will have overtaken its pre-pandemic trend by 2023.

The lacklustre investment of the 2010s was largely blamed on slow output growth and dismal prospects for the economy. By contrast, the vibrant recovery this time is part of a V-shaped rebound encompassing growth, employment and—less happily—inflation. It helps, too, that investment fell less steeply than it did in 2008-09, even as GDP sank at rates not seen since the Depression. Economies shrank in spring 2020 mainly because consumption disappeared as people stayed home.

Yet the investment rebound is not purely a cyclical bounceback. The changes wrought by the pandemic have necessitated more investment, too. The extent to which such investment continues will depend on whether those changes endure. One feature of the pandemic, for instance, has been soaring demand for everything digital. As a result, investment in computers in America is 17% above its pre-covid trend. Roughly a year ago the Taiwan Semiconductor Manufacturing Corporation announced that it would spend \$100bn over three years to expand its chipmaking output. In

mid-January 2022 it upped the stakes, saying it would spend \$40bn-44bn this year alone. Days later Intel, another chipmaker, said it would invest more than \$20bn in two factories in Ohio.

Blockages in the global supply chain for goods have also led to a splurge on new capacity. In 2021 shipping companies ordered the equivalent of 4.2m twenty-foot containers—a record, according to Drewry, a consultancy. Perhaps the archetypal business investment of the pandemic is being made by logistics companies testing whether autonomous cranes can increase throughput at ports and rail terminals.

As the heat of crisis has passed, the pace of the investment rebound has subsided a little. A composite indicator built by JPMorgan Chase, a bank, suggests that global capital spending rose at a underwhelming rate of 2.2% in the fourth quarter of 2021. Economists have recently marked down their forecasts for global GDP growth in 2022 owing to the spread of the Omicron variant of coronavirus and the prospect of tighter monetary policy, both of which might weigh on bosses' willingness to splash out on risky projects.

There are, however, three reasons why business investment might be stronger in the 2020s than it was in the 2010s. The first is that companies are likely to keep spending on their supply chains as they seek to strengthen and diversify them. During the pandemic many have discovered the inconvenience of distant suppliers shutting down when lockdowns or staff shortages strike: factory closures in Vietnam last year, for instance, imperilled America's supply of tennis shoes and yoga pants. Firms must also cope with increasingly fraught geopolitics, which increases the chances of tariffs on trade and state meddling. This may not be good news for economic growth, because fragmentation means duplication and inefficiency. But it does mean tying up more capital.

The second reason to expect more investment is the growing optimism

about the potential of new technologies to boost productivity growth. Not long ago economists fretted that the world was running out of useful ideas. Yet firms are increasingly betting on technological progress. Intellectual property now makes up 41% of America's private non-residential investment, compared with 36% before the pandemic and 29% in 2005. In 2021 the big five technology firms—Alphabet, Amazon, Apple, Meta and Microsoft—alone spent \$149bn on R&D.

Impressive technological advances are everywhere, from synthetic biology and the “messenger RNA” vaccines with which the world is battling covid-19, to areas such as virtual reality and decentralised finance. The advances in some frontier fields are headline-grabbing. In December Synchron, a medical-technology firm, revealed that a man with one of its chips implanted next to his brain's motor cortex had sent a tweet just by thinking it. In January surgeons announced that they had successfully implanted a pig's heart into a man for the first time.

The third force driving investment higher is decarbonisation. A number of countries, together making up 90% of the world economy, have pledged to reduce carbon emissions to net zero over the coming decades in order to fight climate change. If that goal is to be achieved, the world will need everything from electric-vehicle charging infrastructure to battery storage and energy-efficient housing.

Punters are pouring money into green-tinged investment funds, the assets of which amounted to \$2.7trn in the fourth quarter of 2021, according to Morningstar, a data provider. Global investment spending on the transition away from fossil fuels reached \$755bn last year, about half of which was spent on renewable energy, according to BloombergNEF, a research firm. Spending on electric vehicles has risen particularly quickly, by 77% since 2020 to \$273bn, helped along by rapidly shifting consumer preferences and big orders from delivery and car-rental companies.

If net-zero targets are to be met, however, then the green-investment boom still has a long way to run. The Office for Budget Responsibility, Britain's fiscal watchdog, estimates that achieving the country's target by 2050 requires investment worth about 60% of its GDP today, three-quarters of which would have to be stumped up by the private sector. If that share were to apply across the rest of the rich world too, then its need for private-sector green investment would exceed \$20trn at present values. Other estimates of what is needed are higher still.

An investment boom is hardly nailed on. The mass upheaval of supply chains is still a subject that is more often talked about than seen in the statistics. There were plenty of notable advances in the previous economic recovery, which began only two years after the launch of the first iPhone in 2007. Yet investment remained tepid (perhaps because many new technologies seem not to need much capital). Net-zero targets could always be missed.

But the pay-offs to R&D investment, at least, may be rising. In a recent research note Yulia Zhestkova of Goldman Sachs, another bank, found that in America between 2016 and 2019 there was a positive correlation between an industry's investment in intellectual property and its labour-productivity growth. It would not take much of a productivity revival to significantly boost the outlook for growth, which is being weighed down by population ageing. So-called total factor productivity growth, which measures increases in GDP that cannot be attributed to more capital or hours worked, averaged 1.2% a year between 1880 and 2020, notes Ms Zhestkova. By contrast, the figure was only about 0.5% in the 2010s. Simply returning to the historical average would create the prospect of a larger economy in the future, giving firms yet another reason to invest. ■



挥霍的冲动

为什么亮眼的投资增速很可能持续

供应链、技术变革和气候目标都将要求在2020年代增加资本支出

在全球金融危机之后的好些年里，世界经济都缺乏投资。新冠病毒也导致了经济衰退，但其后果却与前者截然不同。在美国，私人非住宅投资目前只比新冠疫情前低大约5%，而在2010年年中也就是上一轮经济周期中一个对应的节点上，这部分投资下滑了近25%（见图表）。投资银行摩根士丹利称，在自上世纪40年代以来的历次经济复苏中，美国这次的商业投资反弹速度是最快的。世界银行预测，到2023年，整个富裕世界的投资总额将超过新冠疫情前的水平。

2010年代的投资低迷很大程度上被归咎于缓慢的产出增长和黯淡的经济前景。相比之下，这次投资强劲复苏是各方面V型反弹的一部分，包括增长、就业，还有让人不太开心的通胀。此外也有所帮助的是，当GDP以大萧条以来未曾有过的速度下滑之时，投资的降幅却不像2008至2009年间那么急剧。2020年春季经济萎缩的主要原因是人们足不出户导致消费缺失。

不过，这次的投资反弹并不完全是周期性复苏。新冠疫情带来的各种变化也让加大投资成为必需。这样的投资会持续到何种地步，取决于这些变化能否持续下去。例如，新冠疫情的一个特征是人们对所有数字产品的需求飙升。结果是美国在计算机上的投资比疫情前高出17%。大约一年前，台积电宣布将在三年内投资1000亿美元扩大芯片产能。1月中旬，它加大押注，表示仅今年一年就将投资400至440亿美元。几天后，另一家芯片制造商英特尔表示，将在俄亥俄州投资逾200亿美元兴建两家工厂。

全球商品供应链大堵塞也引发了大举注资增加运力。咨询公司德鲁里（Drewry）表示，2021年，航运公司订购了相当于420万个20英尺集装箱的新船，创历史新高。或许疫情期间典型的商业投资正是来自物流公司，它们正在检验自动起重机能否提高港口和铁路站点的吞吐量。

新冠疫情危机的顶峰已经过去，投资反弹的速度也已放缓了一些。由摩根大通创建的一个综合指标显示，2021年第四季度，全球资本支出的增速仅为平平无奇的2.2%。经济学家最近下调了对2022年全球GDP增长的预测，原因是奥密克戎毒株传播以及预期货币政策将收紧，而这两点都可能削弱了企业老板们在风险项目上大笔投资的意愿。

然而，2020年代的商业投资可能比2010年代更为强劲，原因有三。首先，企业可能会继续在供应链上砸钱，寻求供应链的韧性和多元化。疫情期间许多公司已经认识到，一旦封锁措施或人手不足使得千里之外的供应商停工，麻烦就来了。例如，去年越南工厂停工就影响了美国网球鞋和瑜伽裤的供应。企业还必须应对日益紧张的地缘政治局势，它加大了征收贸易关税和政府干预的可能性。这对经济增长来说可能不是什么好事，因为分散化意味着重复和低效。但这确实也意味着会在这方面砸下更多资金。

预计会有更多投资的第二个原因是，人们越来越看好新技术在促进生产率方面的潜力。不久前，经济学家们还担心世界已经耗尽了有用的创意。然而，企业越来越多地将赌注押在技术进步上。知识产权现在占美国私人非住宅投资的41%，而这一比例在疫情前为36%，在2005年为29%。2021年，仅Alphabet、亚马逊、苹果、Meta和微软这五大科技公司在研发上就花费了1490亿美元。

引人瞩目的技术进步无处不在，从合成生物学、全球用以抗击新冠病毒的“信使RNA”疫苗，到虚拟现实和去中心化金融。一些前沿领域取得了非常亮眼的进展。去年12月，医疗技术公司Synchron透露，它的一款芯片被植入到一名男子的大脑运动皮层旁边，让他仅凭意念就发送了一条推特。今年1月，外科医生宣布他们首次成功地将猪的心脏植入了人体。

推动投资增长的第三股力量是脱碳。为应对气候变化，加起来占世界经济总量90%的一些国家已经承诺，在未来几十年将碳排放减少到净零。要实现这一目标，世界将需要各种各样的新事物，包括电动汽车充电基础设施、蓄电池、节能住宅等等。

投资者正把大量资金投入与环保沾边的投资基金中。据数据供应商晨星（Morningstar）统计，2021年第四季度这些基金的资产总额达到2.7万亿美元。研究公司彭博新能源财经（BloombergNEF）的数据显示，去年，全球花在化石燃料转型上的投资达到7550亿美元，其中约一半用于可再生能源。对电动汽车的支出增长尤其迅速，自2020年以来增长了77%，达到2730亿美元，这也得益于消费者偏好的迅速转变，以及快递和汽车租赁公司的大额订单。

不过，要实现净零排放的目标，这股绿色投资热潮还远远不够。英国财政监督机构预算责任办公室（Office for Budget Responsibility）估计，英国要想在2050年前实现碳排放目标，所需的投资相当于目前GDP的60%，其中四分之三必须由私营部门承担。如果这一比例也适用于所有其他发达国家，那么按现值计算，它们的私营部门需要在环保上投资逾20万亿美元。其他对所需投资的估算得出的数字还要更高。

投资强劲的前景并不确定。供应链剧变更多还只存在于话题中，尚未见于统计数据。在2007年第一代iPhone发布的仅仅两年后，上一次的经济复苏就开始了，复苏其间取得了许多显著的技术进步。但当时投资一直不温不火（也许是因为许多新技术似乎不需要太多的资金）。净零排放的目标总是有可能落空。

但至少，在研发上的投资回报可能正在上升。高盛的女利娅·哲斯托科娃（Yulia Zhestkova）在最近的一份研究简报中发现，在美国，2016年至2019年期间，一个行业在知识产权上的投资与其劳动生产率的增长之间具有正相关关系。生产率只要稍微复苏便可显著提振经济增长的前景，而目前这一前景正受到人口老龄化的拖累。哲斯托科娃指出，从1880年到2020年，所谓的全要素生产率（衡量经济产出当中不能归因于资本和劳动力增长的那部分变化）平均每年增长1.2%。相比之下，2010年代的这一数字仅为0.5%左右。只要恢复到历史平均水平，就能创造出未来经济增长的前景，这就给了企业又一个投资的理由。■



A slippery patch

OPEC grapples with a precariously balanced oil market

Geopolitical drama and a tight market mean that a price of \$100 per barrel could be on the cards

OIL AND philosophy rarely mix. But when David Fyfe of Argus Media, a publisher, calls production quotas set by the Organisation of Petroleum Exporting Countries (OPEC) and its allies a “Platonic ideal”—more of a theoretical model than a practical guide—he captures the sense of self-doubt now gripping energy markets. Every month since July, the group has agreed to raise its output by 400,000 barrels per day (bpd). But experts cannot decide whether that is too little or too much—and whether the target means much at all.

The cartel’s latest meeting, on February 2nd, took place against the backdrop of heightened fears about a Russian invasion of Ukraine (Russia, the world’s second-biggest oil exporter, is a member of the extended cartel, known as OPEC+). Only the week before the price of a barrel of Brent crude had spiked above \$90, its highest level in seven years. The alliance promised to raise output again, by the usual amount. That calmed markets a bit. The question is what happens next.

Many Wall Street analysts have lifted their oil-price forecasts for this year above \$100 a barrel. War in Ukraine, they say, could push it well past \$120. Conflict would probably not physically disrupt supply. By contrast with the gas it pipes to Europe, Russia mostly exports oil by sea. Instead, a fear of potential sanctions on trade may set prices ablaze.

Geopolitics aside, the bull case rests on resurgent demand. The International Energy Agency reckons oil consumption will rise from its present level of about 97m bpd to 100m bpd—a return to pre-covid

levels—by the end of the year, even before global aviation fully recovers. Damien Courvalin of Goldman Sachs, a bank, says consumers switching to oil from gas (prices for which have been sky-high in Europe) may have boosted demand by up to 1m bpd, leading to “critically low inventory levels”.

Supply is tight, too. Paul Sheldon of S&P Global Platts, a data firm, reckons global spare production capacity is only about 2.6m bpd. And pledges by OPEC+ cannot be counted on. Many members have struggled to raise output owing both to underinvestment and covid-related bottlenecks. BloombergNEF, a research firm, notes that in December the club produced 747,000 fewer barrels a day than its quotas allowed.

The bear case rests on patience, a Persian restoration and a Permian boom. If Russian exports are not cut off, then the impact of geopolitical tensions should dissipate by the summer. By then America will probably have raised interest rates, cooling growth and oil demand—just as extra supply from OPEC+ hits the market. A resumption of Iran’s nuclear deal, meanwhile, looks likelier than at any point since 2017, when it was torn apart. The associated lifting of sanctions could release another 1m bpd.

The real wild card is shale. Until 2014, when OPEC orchestrated an oil-price crash, shale drillers raised cheap finance to ramp up output, turning America into the world’s biggest producer of oil. But investors, who went on to lose perhaps \$300bn, are now demanding high returns.

Oil bosses have talked of stern capital discipline. Yet lofty prices are hard to resist. Baker Hughes, an oil-services firm, counts 610 active rigs in America in late January, 226 more than a year ago. BNEF predicts output in the Permian basin could rise by as much as 1m bpd by the end of 2023; ExxonMobil, an oil major, plans to increase output there by a quarter this year. As energy philosophers like to say, the best cure for high prices is high

prices. ■



湿滑路段

欧佩克艰难应对走势不稳的石油市场

地缘政治动荡和市场吃紧意味着油价可能升至每桶100美元

石油和哲学通常八竿子打不着。但价格评估机构阿格斯（Argus Media）的大卫·法伊夫（David Fyfe）说欧佩克（OPEC）及其盟友制定的生产配额是一种“柏拉图式的理想”（即更像是个理论模型，而非实用指南）。他捕捉到了目前笼罩能源市场的自我怀疑氛围。去年7月，欧佩克同意每月上调产量日均40万桶。但专家们无法判断这是过少还是过多，也不知道这个目标是否真有意义。

欧佩克在2月2日召开了最新一次会议，此时市场对俄罗斯入侵乌克兰的忧虑在加剧。俄罗斯是世界第二大石油出口国，也是欧佩克与非欧佩克产油国长期合作机制（俗称“欧佩克+”）的一员。再往前一周，布伦特原油的价格曾飙升至突破每桶90美元，是七年来的最高位。欧佩克承诺将再次按惯常幅度提高产量。市场因而稍微平静下来。但问题是接下来会发生什么。

华尔街许多分析师已把今年的油价预测提高至每桶100美元以上。他们表示，乌克兰如果爆发战争，可能推高油价至远超120美元。战事大概不会从实体设施上扰乱供应。俄罗斯通过管道向欧洲输送天然气，但出口石油则主要靠海运。反而是对可能出现贸易制裁的担心会导致价格暴涨。

撇开地缘政治不谈，市场看涨的理由是需求复苏。据国际能源署（IEA）估计，到今年底，即使全球航空业未完全复苏，石油消费量也将从目前的每天9700万桶上升到每天一亿桶，也就是恢复到疫情前的水平。高盛的达米安·库瓦林（Damien Courvalin）表示，消费者从天然气（欧洲的天然气价格已经涨破了天）转向石油可能导致了需求增加每天100万桶，造成“库存水平极低”。

供应也很紧张。数据公司标普全球普氏（S&P Global Platts）的保罗·谢

尔顿（Paul Sheldon）认为，全球备用石油产能仅约为每天260万桶。而且不能指望欧佩克+的承诺。由于投资不足和疫情导致的瓶颈，许多成员国都难以提高产量。研究公司彭博新能源财经（BloombergNEF）指出，去年12月欧佩克+的石油日产量比配额少了74.7万桶。

看跌的观点则基于三个因素：市场耐心、波斯湾油气区恢复，以及二叠纪盆地石油产量增长。假如俄罗斯的出口没被切断，到今年夏季，地缘政治局势的影响应该就会消散。那时候美国可能已经加息，经济增长和石油需求因而降温，欧佩克+增加的石油供应也会在那时进入市场。同时，伊核协议（2017年被撕毁）似乎极有可能在今年恢复。如果相关制裁措施得以解除，可能会再释放每天100万桶油的供应。

真正的未知数是页岩油。直到2014年欧佩克策划油价暴跌的戏码前，页岩油开采商成功筹集到了廉价资金来提升产量，把美国变成了全球最大的石油生产国。但之后投资者损失了大概3000亿美元，如今他们在要求高回报。

石油老板们大谈严格遵照资本纪律。但高油价的诱惑难以抵挡。据油田服务公司贝克休斯(Baker Hughes)统计，1月底美国活跃钻机数量为610台，比一年前多了226台。彭博新能源财经预测，到2023年底，二叠纪盆地的日产量可能增加多达100万桶；石油巨头埃克森美孚计划今年把那里的产量提高四分之一。正如能源哲学家们爱说的，高价还须高价医。■



Free exchange

China may soon become a high-income country

Has it truly escaped the middle-income trap?

CHINA IS HAUNTED by the spectre of the “middle-income trap”, the notion that emerging economies grow quickly out of poverty only to get stuck before they get rich. “During the next five years, we must take particular care to avoid falling into the middle-income trap,” said Li Keqiang, China’s prime minister, in 2016. Lou Jiwei, then China’s finance minister, once put the odds of China becoming ensnared at 50%.

The trap was named by Homi Kharas and Indermit Gill, two economists, in 2006, when they were both at the World Bank. It raises an obvious question: what counts as middle income and what would qualify as surpassing it? Mr Kharas and Mr Gill adopted the bank’s own income classifications. These were established in 1989 when the bank drew a line separating high-income countries from the rest. The line had to accommodate all of the countries that were then considered “industrial market economies”. It was drawn at a national income per person of \$6,000 in the prices prevailing in 1987, just low enough to include Ireland and Spain. That line is now \$12,695. It rises in step with a weighted average of prices and exchange rates in five big economies: America, Britain, China, the euro area and Japan. Eighty countries met that threshold in 2020, three fewer than the year before. The pandemic relegated Mauritius, Panama and Romania to the middle division.

Despite its leaders’ fears, or perhaps because of them, China is now on the cusp of becoming a high-income country by this definition (see chart). Based on the latest available forecasts from Goldman Sachs, we calculate that China could cross the line next year, helped in part by its strong currency. (The transition would not be officially announced until

mid-2024, when the World Bank updates its classifications based on the previous year's data.) If we are right, then 2022, the year of the tiger, could be China's last as a middle-income country. It will be a fatter cat thereafter.

The threshold, of course, is arbitrary. Several countries (including Argentina, Russia and even Venezuela) have surpassed it only to flounder or fail in subsequent years. A lasting escape from the middle-income trap requires a more fundamental transition. Countries at this intermediate stage of development can encounter a variety of pitfalls. They may face diminishing returns to capital. They typically run out of workers to move out of agriculture. And they must invest heavily in education, beyond the basic schooling a factory hand needs to follow instructions. The truer test of a high-income country is how well it copes with such threats to its growth. How is China faring on these three counts?

China is still accumulating capital at a furious pace. It invested 43% of its GDP in the five years before the pandemic. The high-income countries averaged only half that percentage. But China's high investment rate is perhaps not as fruitless as is often assumed. Just as its investment remains high by the standards of rich countries, so does its GDP growth rate. Indeed, the ratio between its investment share in output and its growth rate (sometimes called the incremental capital-output ratio, or ICOR) still looks favourable in comparison with high-income countries.

What about other sources of growth? In its annual check-up of China's economy, released on January 28th, the IMF noted with concern that China's "total factor productivity" growth, which measures changes in output that cannot be attributed to more capital or labour, fell in the past decade, compared with the ten years before. It attributed this slackening to "a stalling" of structural reforms, especially of state-owned enterprises. "Market dynamism has been losing steam recently," it argued. But this kind of productivity is notoriously hard to measure. And according to one gauge

from the Conference Board, a business group, it is rising notably faster in China than in high-income countries (see chart).

China's employment patterns still differ markedly from those of more prosperous countries. Surprisingly, perhaps, the share of its workforce in construction is lower than the high-income average. The percentage in manufacturing is higher (19% compared with an average of 13%) and the share still in agriculture is far higher—about 25% compared with a high-income average of 3%. From one perspective, this residual rural workforce is a reason for optimism. If China can achieve high-income levels with a quarter of its workers marooned in agriculture, imagine what it will do as they escape into more productive employment? The worry, however, is that these workers have not left the farms because they cannot. Perhaps they do not want to forfeit their claims on communal land. Or perhaps they are too old or poorly educated to take advantage of better opportunities in cities.

China's stock of human capital is indeed a cause for concern. According to its latest census, its adult population had an average of 9.9 years of schooling in 2020. That would put it near the bottom of the heap of high-income countries, which have 11.5 years on average, according to Robert Barro of Harvard and Jong-Wha Lee of Korea University.

| *The high-income trap*

This problem can only be fixed one cohort at a time. China's older citizens grew up in a much poorer country and were educated accordingly. A child now entering China's school system could expect to receive 13.1 years of education, according to the World Bank. The quality does not yet match the quantity: based on how well children score on standardised tests, 13 years of school in China is equivalent to less than ten years in a country like Singapore, the bank calculates. Nevertheless, things have improved.

The "stock" of human capital reflects China's impoverished past, then, but

the “flow” of investment in new human capital is more befitting of a high-income future. The problem is that this costly investment of money and time is deterring parents from having children, a demographic deadlock that is sadly characteristic of many rich parts of the world. China’s population increased last year by only 0.03%. Judging by Japan’s experience, an ageing, declining population can contribute to depressed spending, low growth and low interest rates. China’s policymakers must now worry about a different kind of trap. ■



自由交流

中国可能很快将成为高收入国家

它真的躲过了中等收入陷阱吗？

“中等收入陷阱”的阴影笼罩着中国，这个概念是指新兴经济体在迅速脱离贫困后停滞不前，迟迟不能晋升富裕国家。2016年，中国总理李克强表示：“今后五年是跨越‘中等收入陷阱’的重要阶段。”时任财政部长楼继伟曾称中国有50%的可能性滑入这一陷阱。

2006年，当时在世界银行任职的两位经济学家霍米·卡拉斯（Homi Kharas）和印德尔米特·吉尔（Indermit Gill）首先提出了中等收入陷阱的概念。随之而来的是一个显而易见的问题：什么是中等收入，怎样才算超越了它？卡拉斯和吉尔采用了世行的收入划分方法。这种划分始于1989年，当时世行划定了一条线来区分高收入国家与其他国家。这条线之上必须包括当时被视为“工业化市场经济体”的所有国家。根据1987年的价格，它定在了人均国民收入6000美元，刚好能把爱尔兰和西班牙包括进来。这条线现在是12,695美元。它与五大经济体（美国、英国、中国、欧元区和日本）的价格和汇率加权平均值同步上升。2020年有八十个国家处在这条线之上，比前一年少了三个。新冠疫情导致毛里求斯、巴拿马和罗马尼亚降级为中等收入国家。

尽管中国领导人忧虑“陷阱”（又或者正是由于这种忧虑），根据上述定义，中国现在已处于成为高收入国家的边缘（见图表）。根据高盛的最新预测，我们估计中国可能会在明年跨过这条线，这在一定程度上得益于人民币的强势。（这一转变要到2024年年中才会正式宣布，届时世行将根据前一年的数据更新划分标准。）如果我们的判断正确，那么2022这个虎年将是中国作为中等收入国家的最后一年。此后中国将会成为富裕国家。

当然，这个门槛只是一个人设定的数值。一些国家（包括阿根廷、俄罗斯，甚至委内瑞拉）都曾跨越了门槛，但在随后几年里却陷入困境或遭遇失败。要想持久摆脱中等收入陷阱，就需要更为根本的转型。处于中间发

展阶段的国家会碰到各种困难。资本回报可能递减。从农业社会转型时往往人力不足。它们还必须大力投资于教育，而不止步于让工厂工人能遵循指令所需的基础教育。要成为一个高收入国家，真正的考验正是如何应对这些威胁增长的因素。那么，中国在这三个方面的表现如何？

中国仍在以惊人的速度积累资本。在疫情前的五年里，中国的投资额达到GDP的43%。高收入国家的平均水平只有这个数字的一半。但中国的高投资率也许并不像人们通常认为的那样徒劳无功。按照富裕国家的标准，中国保持了较高的投资率，而它的GDP增速也保持在高位。事实上，相比高收入国家，中国的投资占产出的比例与其增长率之间的比率（也称为增量资本产出率，缩写为ICOR）仍处于较好水平。

其他增长来源又如何？国际货币基金组织（IMF）在1月28日发布的对中国经济的年度评估中关切地指出，在过去十年里中国的“全要素生产率”（衡量经济产出中不能归因于资本和劳动力增长的那部分变化）增速比前一个十年有所下降。报告将这种放缓归结为结构性改革的“停滞”，尤其是国企改革。IMF认为，“近期市场活力正在丧失”。但众所周知，这种生产率指标极难衡量。根据商业团体世界大型企业联合会（Conference Board）的测算，这个指标在中国的增速明显快于高收入国家（见图表）。

中国的就业结构仍然与更富裕的国家存在明显差异。中国的建筑业就业比例低于高收入国家的平均水平，这也许令人惊讶。制造业的就业比例更高（19%，平均水平为13%），而农业的就业比例约为25%，远高于高收入国家平均3%的水平。从一个角度看，这些剩余的农村劳动力是一个让人乐观的理由。如果中国能在四分之一的劳动力在务农的情况下就达到高收入水平，那么想象一下，如果这些人离开农村、进入生产率更高的就业岗位时会如何？然而，令人担忧的是这些劳动力之所以没有离开农田是因为他们无法离开。也许他们不想放弃集体土地的所有权。又或者他们年纪太大，或者受教育水平太低，无法抓住在城市里那些更好的机会。

中国的人力资本存量确实堪忧。根据最新的人口普查，2020年中国成人的平均受教育年限为9.9年。这使中国在所有高收入国家当中处于几乎垫底

的位置——根据哈佛大学的罗伯特·巴罗（Robert Barro）和高丽大学的李钟和的调查，高收入国家的受教育年限平均为11.5年。

| 高收入陷阱

解决这个问题必须区分不同人群。年纪较大的中国人的成长环境要贫穷得多，接受的教育相应也差得多。世行的数据显示，如今进入中国教育系统的孩子预计会接受13.1年的教育。中国教育的年数增加了，但质量尚未跟上：根据中国儿童在标准化考试中的成绩，世行计算出中国13年的学校教育只相当于新加坡等国不到10年的教育水平。尽管如此，情况还是改善了。

因此，人力资本的“存量”反映了中国贫困的过去，但对新人力资本的投资“流量”更适合高收入的未来。问题是这种昂贵的金钱和时间投入导致父母不愿生育，很遗憾，这是世界许多富裕地区所共有的一种人口结构僵局。去年中国人口仅增长了0.03%。从日本的经验来看，老龄化和人口减少可能导致消费萎缩、低增长和低利率。中国的决策者现在必须担忧另一种陷阱了。■



Acquired immunity

How is Omicron affecting the global economic recovery?

High-frequency data suggest the effect may be limited—and short-lived

LATE NOVEMBER almost began to feel like the early days of the pandemic all over again. Global stockmarkets fell as news of what would come to be known as the Omicron variant filtered out and investors feared either another round of restrictions, or that people would shut themselves away. Two months on, Omicron's impact is slowly coming into focus. So far it is, largely, better than feared. Markets are skittish, but because of the prospect of higher interest rates, rather than covid-19. Goldman Sachs, a bank, has constructed a share-price index of European firms, such as airlines and hotels, that thrive when people are able and willing to be in public spaces. The index, a proxy for anxiety about the virus, has surged relative to wider stockmarkets in recent weeks.

High-frequency economic data back up the cautious optimism. Nicolas Woloszko of the OECD, a rich-country think-tank, produces a weekly GDP index for 46 middle- and high-income economies, using data from Google-search activity on everything from housing and jobs to economic uncertainty. Adapting his index, which has been a good predictor of the official numbers, we estimate that GDP across these countries is about 2.5% below its pre-pandemic trend (see chart 1). That is a little worse than in November, when GDP was 1.6% below trend, but better than a year ago, when output was nearly 5% below it.

A few factors explain why the worst fears about the variant's economic effects have so far not come to pass. The great uncertainty with Omicron relates to whether the bad (greater transmissibility) outweighs the good (lower virulence), and thus whether there is a damaging surge in hospitalisations and deaths from covid-19. So far, though, few governments

apart from China's, which is still wedded to its zero-covid strategy, seem to believe that additional drastic restrictions on people's movements are required.

A quantitative measure produced by UBS, a bank, ranks global restrictions from zero to ten and finds that the average global score has risen from 3 to 3.5 in recent weeks. Only one rich country, the Netherlands, moved into a proper lockdown (though this was relaxed on January 26th). UBS also finds that the share of international travel routes with covid-related entry restrictions, at 31% globally, has barely budged since October.

More people also seem happy to take risks. Goldman Sachs produces an "effective" lockdown index, which takes into account not only governments' diktats but also people's choices. So far its global index has tightened to about the same level as during the Delta wave of last summer, despite four to five times as many daily infections. Even in places where the rapid spread of covid-19 is a novelty, people are largely carrying on as normal. Cases in San Francisco were in the low double digits for most of the autumn. Although the city now averages about 2,000 a day, gyms and restaurants remain busy. Our global "normalcy index", which looks at how people's behaviour has changed relative to pre-covid norms, dropped in recent weeks, but now seems to be recovering.

Today's case numbers suggest that about 5-10% of Americans currently have covid-19. Such high prevalence has created a new difficulty that did not exist with previous variants: a widespread absence of workers. According to a survey conducted at the turn of the year by the Census Bureau, 8.8m Americans were out of work either because they were caring for someone with covid-19 or because they had the disease themselves. At the end of 2021, 138 National Basketball Association players were unable to work for covid-related reasons, though this number has since dropped. In San Francisco a small but growing number of shops, which had already

been struggling with a labour shortage, are closing early for lack of staff.

Measuring the effect of such absences on output is hard, but it looks likely to be limited—and short-lived. For a start, several factors might offset their impact. Some of the workers who are isolating will be able to toil from home. If a restaurant is closed, prospective diners may still have other places to visit. And for a time at least, co-workers who are uninfected can take up some of the slack. The overall drag could therefore be modest. Research published earlier this month by JPMorgan Chase, another bank, for instance, speculated that absences could reduce Britain's GDP in January by 0.4%.

Moreover, with case numbers falling both in Britain and in some cities in America, Omicron's economic effects look likely to fade rapidly. Forward-looking surveys also suggest that firms are not too worried. There is little sign, for instance, of a decline in business confidence (see chart 2).

Despite a better overall performance than expected, the global economic recovery from the lockdowns of 2020 is still uneven. The gap between the best and worst performers is as wide as it has ever been. As South Africa's Omicron wave has collapsed, GDP has risen and is now in line with its pre-crisis trend. Britain's economy seems to be recovering fairly quickly.

Other places are still struggling, however, whether because of a slow roll-out of boosters, low population immunity or plain bad luck. According to the OECD's measure, the Spanish economy is still roughly 7% smaller relative to its pre-covid trend. Omicron has not done too much to knock the global economic recovery off course. But some places still feel a long way from normal. ■



获得性免疫

奥密克戎如何影响全球经济复苏？

高频数据表明它的影响可能有限——而且短暂

去年11月下旬，气氛简直开始有点像疫情爆发之初了。随着有关新变异株奥密克戎的消息逐渐扩散，投资者担心新一轮限制措施将出台或是人们会自我隔离，全球股市因而下跌。两个月过去了，奥密克戎的影响逐渐明朗起来。到目前为止，大体来说情况并没有人们担心的那么严重。市场情绪有些焦躁不安，但并不是因为疫情，而是因为对加息的预期。高盛创建了一个航空公司和酒店等欧洲公司的股价指数，这类公司会在人们能够并愿意进入公共场所时红火起来。这个揭示对病毒焦虑程度的指标在最近几周相对于更广泛股市大幅上升。

高频经济数据支持这种谨慎乐观的情绪。富裕国家智库经合组织的尼古拉斯·沃洛斯科（Nicolas Woloszko）为46个中高收入经济体建立了每周GDP指数。该指数透过人们在谷歌上搜索住房、就业以及经济不确定性等各种信息的频率数据来窥探经济走势，一直能够很好地预测官方数据。本刊调整该指数后统计得出，现在这46国的GDP比疫情前低约2.5%（见图表1）。这比11月的数据稍差，当时的GDP比疫情前低1.6%，但好于一年前，那时低近5%。

迄今为止，对奥密克戎冲击经济的最大担忧没有成为现实，这有几个因素可以解释。奥密克戎有着巨大的不确定性，要看其弊的一面（传播性更强）是否大于利（毒性较弱），以及新冠肺炎的住院和死亡人数是否会因此出现破坏性激增。不过到目前为止，除了仍然坚持清零政策的中国之外，极少有政府认为需要额外严格限制人员流动。

瑞银制定的一个量化标准按十分制给全球疫情限制情况打分，最近几周全球平均得分从3上升到了3.5。只有荷兰这一个富裕国家进入了真正的封锁状态（但在1月26日放宽）。瑞银还发现，自去年10月以来，全球有疫情入境限制要求的国际旅行路线占比几乎没有变化，一直保持在31%。

乐于冒险的人也似乎更多了。高盛制定了一个“有效”封锁指数，不仅计入政府的命令，也计入了人们的选择。到目前为止，它的全球指数已收紧至与去年夏天德尔塔疫情期间大致相同的水平，尽管现在每日感染人数是当时的四到五倍。即使在首次发生病毒迅速传播的地方，人们的生活也基本照旧。在去年秋天的大部分时间里，旧金山每天都只有十来例确诊病例。尽管这座城市现在平均每天约有2000人确诊，但健身房和餐馆里仍然熙来攘往。本刊全球“常态指数”着眼于人们的行为相对于疫情之前的常态所发生的变化，这一指数最近几周有所下降，但现在似乎又回升了。

按照现在的病例数，约有5%至10%的美国人正患有新冠肺炎。如此高发病率带来了之前的毒株未曾引发过的新难题——普遍人力不足。根据美国人口普查局年初的一项调查，美国有880万人因为要照顾新冠病人或自己感染而离开岗位。去年底，138名NBA球员因新冠肺炎相关原因暂时离队，不过今年以来这个数字已有所下降。旧金山的一些商店本来就已经因为人手不足而犯难，现在每天提前结束营业。这样的商店为数不多，但在不断增加。

很难衡量人力不足对经济的影响，但看起来这种影响很可能有限且短暂。首先，有几个因素可能会起到抵消作用。一些正在隔离的员工可以居家工作。一家餐厅关了，食客们可能还有其他餐厅可去。至少在一段时间内，没有感染病毒的同事可以顶替一些工作。因此，整体而言拖累可能不大。例如，另一家银行摩根大通上月发表的研究认为，估计人力不足可能让英国1月的GDP下降0.4%。

此外，鉴于英国全国和美国一些城市的病例数都在下降，奥密克戎对经济的影响看起来很可能会迅速消退。从前瞻性问卷来看，企业并不太担心。例如，商业信心并没有什么下跌的迹象（见图表2）。

尽管整体表现好于预期，但全球经济从2020年的封锁中复苏的步调仍不一致。表现最佳者和最差者之间的差距与以往一样大。随着南非的奥密克戎疫情走向终结，GDP开始上升，现在已回归疫情前走势。英国的经济似乎恢复得相当快。

但其他地区还在挣扎，无论是因为加强针接种缓慢、人群免疫力低下，还是纯粹运气不佳。据经合组织测算，西班牙经济仍比疫情前水平低约7%。奥密克戎并没有让全球经济复苏过多地偏离轨道，但某些地方要恢复正常似乎仍有很长的路要走。 ■



Risky business

A history and defence of venture capital in “The Power Law”

It is a vital feature of modern capitalism, says Sebastian Mallaby

The Power Law. By Sebastian Mallaby. Penguin Press; 496 pages; \$30. Allen Lane; £25

NOT EVERYONE is a fan of venture capitalists (VCs). One academic famously questioned whether they were “soulless agents of Satan, or just clumsy rapists?” Paul Graham, the co-founder of the Y Combinator startup incubator, published a “unified theory of VC suckage”, in which he likened the industry’s investment process to a body-cavity search by someone with a faulty knowledge of anatomy. Venture capitalists, he concluded, resembled classic villains: “alternately cowardly, greedy, sneaky and overbearing”.

More recently, VCs have been blamed for propagating some of the ills of Big Tech: the monopolisation of markets, the erosion of privacy and the degradation of workers’ rights in the gig economy. By prioritising growth over governance at all costs, they stand accused of feeding a recklessly aggressive capitalist culture that contributed to scandals at Uber, WeWork and Theranos.

In “The Power Law”, Sebastian Mallaby acknowledges some of the industry’s shortcomings, most notably its shocking lack of diversity. But he zealously defends the overall achievements of the VC industry, which has funded many of the modern world’s most useful inventions (search engines, smartphones, vaccines), disrupted cosy monopolies and generated eye-popping wealth. He even claims that VCs have emerged as a “third great institution of modern capitalism”, combining the organisational strengths of companies with the flexibility of markets. Little surprise that the VC

model has now gone global, with particularly striking results in China.

In his well-researched book, leavened by lively portraits of leading figures, Mr Mallaby explores the history of the VC industry and the reasons for its vitality. A journalist at The Economist in the 1980s-90s (and husband of the current editor-in-chief), he previously wrote a study of the hedge-fund industry and an acclaimed biography of Alan Greenspan.

Some histories of Silicon Valley, such as Margaret O'Mara's "The Code", have emphasised the importance of American military spending in seeding the west-coast tech industry. Mr Mallaby's focus is overwhelmingly on the entrepreneurs, investors and firms that nurtured its growth. Much of the VC industry's success is attributed to its mentality. In evaluating investments, VCs still take after the pioneering Arthur Rock, who zeroed in on the "intellectual book value" of a company rather than the financial kind. They accept extreme financial risk, embrace immigrants and tolerate nerds and misfits, who account for so many successful entrepreneurs. Four of PayPal's six early employees reputedly built bombs in high school.

While VCs love backing companies that enjoy so-called network effects, they benefit from their own version of this phenomenon, too. Sand Hill Road, where many of the leading VC firms are clustered, may have the air of a row of gentlemen's clubs but it has enabled the free flow of ideas, favours and connections. That is partly why the Silicon Valley model has been so hard to replicate elsewhere.

As the author describes, the VC world has experienced considerable churn in the past 60 years and has lately been disrupted as much as it has been disruptive. Capital-rich outsiders, including DST Global, SoftBank and Tiger Global Management, have all muscled in on what was once a cottage industry. By deploying masses of money later in the investment cycle, these indulgent newcomers have enabled startups to delay listing on public

markets. In Mr Mallaby's view, that trend partly accounts for the misgovernance at some scandal-ridden tech companies because it has cut the ties between interventionist VC investors and freewheeling entrepreneurs.

Some west-coast VC firms, such as Sequoia Capital and Andreessen Horowitz, have responded to the new challengers by raising ever-bigger funds and diversifying, both geographically and sectorally. This has only fuelled talk that Sand Hill Road is becoming the new Wall Street. Yet even the biggest traditional VC firms remain tiny compared with giant public-market funds. Some investors wonder why they should bother with risky VC bets when the returns in public markets can be so spectacular.

Take Apple, which recently popped above \$3trn in market value compared with the \$1.8bn it was worth when it floated in 1980. It seems improbable that the VC industry, which has helped so many startups to "blitzscale", can ever do so itself.

John Thornhill We identify the reviewers of books connected to The Economist or its staff. Mr Thornhill is Innovation Editor of the Financial Times. ■



冒险生意

《幂法则》讲述风险投资的历史并为其辩护

马拉比认为它是现代资本主义的关键特征【《幂法则》书评】

《幂法则》，塞巴斯蒂安·马拉比著。企鹅出版社，496页；30美元。艾伦莱恩出版社，25英镑。

不是每个人都对风险资本家（VC）抱有好感。一位学者发出的一句诘问十分出名：他们究竟是“没有灵魂的撒旦代理人，还是只是笨拙的强奸犯？”创业公司孵化器Y Combinator的联合创始人保罗·格雷厄姆（Paul Graham）发表了《VC劣迹统一理论》一文，将该行业的投资流程比喻为一个对人体结构一知半解的人在做体腔检查。风险投资家就像典型的恶棍，他总结道，“时而懦弱，时而贪婪，时而卑鄙，时而霸道”。

更近些时候，人们指斥VC传播科技巨头的一些疾患，比如垄断市场、侵犯隐私，以及零工经济中工人权益的倒退。他们不惜一切代价追求增长而轻忽治理，这种模式让他们很容易就被指责喂养了一种肆无忌惮的激进资本主义文化，继而促发了优步、WeWork和Theranos等公司的丑闻。

在《幂法则》（The Power Law）一书中，塞巴斯蒂安·马拉比

（Sebastian Mallaby）承认该行业存在一些缺点，尤其是严重欠缺多样性。但他也为VC行业的整体成就积极辩护，指出它资助了现代世界许多最有用的发明（搜索引擎、智能手机、疫苗），颠覆了安逸的垄断，创造了令人瞩目的财富。他甚至声称，VC结合了公司的组织优势与市场的灵活弹性，已经成为“现代资本主义的第三大制度”。无怪乎VC模式如今已风靡全球，在中国的成绩尤为亮眼。

这本书的研究深入详尽，并佐以对领军人物的生动描述。马拉比在书中探讨了VC行业的历史及其蓬勃生命力的源泉。他曾在上世纪八九十年代担任《经济学人》记者（也是现任总编的丈夫），写过关于对冲基金行业的研究著作，以及一本广受好评的格林斯潘传记。

一些关于硅谷的历史记述，如玛格丽特·奥玛拉（Margaret O'Mara）的《代码》（The Code），强调了美国军费开支在培育西海岸科技产业中的重要作用。马拉比则几乎完全聚焦于推动了科技行业发展的企业家、投资者和公司。VC行业的成功很大程度上被归因于思考方式。在评估投资项目时，VC们仍然遵循先驱人物阿瑟·洛克（Arthur Rock）的理念，即更关注一家公司的“知识账面价值”，而不是财务账面价值。他们愿意承担极端的财务风险，接纳移民，容忍书呆子和不合群者——众多成功企业家都是这类人。据说，在PayPal最早的六名员工中，有四人曾在高中时制造过炸弹。

VC喜欢投资那些享有所谓网络效应的公司，而他们本身同样获益于自己内部的网络效应。许多顶尖VC公司都聚集在硅谷沙山路（Sand Hill Road），这里或许散发着一股精英男士俱乐部林立的气氛，但它确实也让思想、资助和人脉得以自由流动。某种程度上，这也是硅谷模式难以在其他地方复制的原因。

正如作者所述，VC世界在过去60年里经历过大起大落，而过去它怎么颠覆别人，如今别人就怎么颠覆它。包括DST Global、软银和老虎环球基金（Tiger Global Management）等资本雄厚的外来者都已强势挤入这个曾经的小众行业。这些有钱任性的新进入者在投资周期的后期注入大笔资金，让创业公司可以不急于到公开市场上市了。在马拉比看来，这种趋势是一些丑闻缠身的科技公司治理不善的原因之一，因为它切断了干预主义的VC投资者和自由不羁的企业家之间的纽带。

为迎战挑战者，一些美国西海岸的VC公司，如红杉资本（Sequoia Capital）和安德森-霍洛维茨基金（Andreessen Horowitz），已经开始募集更多资金，并在地域和行业上都加大多元化。结果只是让沙山路正在成为新的华尔街的说法甚嚣尘上。然而在巨无霸式的公开市场基金面前，即使最大型的传统VC公司仍然十分渺小。一些投资者不禁要琢磨，既然公开市场的回报能如此惊人，何必还要涉足高风险的VC赌局呢？

以苹果为例，该公司最近的市值突破了3万亿美元，而1980年上市时仅为

18亿美元。VC行业帮助众多创业公司实现了“闪电式扩张”，而它自己却不太可能会有这么一天。





Free exchange

Economists are revising their views on robots and jobs

There is little evidence of a pandemic-induced surge in automation

WHEN THE pandemic first struck, unemployment soared. Not since the Depression had American joblessness surpassed 14%, as it did in April 2020. But fears of a prolonged period of high unemployment did not come to pass. According to the latest available data, for November, the unemployment rate for the OECD club of mostly rich countries was only marginally higher than it was before the pandemic. By now it may even have drawn level. The rich world's labour-market bounceback is the latest phenomenon provoking economists to look again at a foundational question in the discipline: whether robots help or harm workers.

The gloomy narrative, which says that an invasion of job-killing robots is just around the corner, has for decades had an extraordinary hold on the popular imagination. Warning people of a jobless future has, ironically enough, created plenty of employment for ambitious public intellectuals looking for a book deal or a speaking opportunity. Shortly before the pandemic, though, other researchers were starting to question the received wisdom. The world was supposedly in the middle of an artificial-intelligence and machine-learning revolution, but by 2019 employment rates across advanced economies had risen to all-time highs. Japan and South Korea, where robot use was among the highest of all, happened to have the lowest rates of unemployment.

Many thought that the pandemic would at last prove the doom-mongers right. In mid-2020 a highly cited paper published by America's National Bureau of Economic Research argued that covid-19 "may accelerate the automation of jobs", and another asserted that it was "reinforcing both the trend towards automation and its effects". A paper published by the IMF

wondered whether the jobs lost during the pandemic would “come back”. Part of the logic was that since robots don’t fall ill, bosses would turn to them instead of to people—as seemed to have happened in some previous pandemics. Others noted that bursts of automation tend to occur during recessions.

Two years on, though, the evidence for automation-induced unemployment is scant, even as global investment spending is surging. The rich world faces a shortage of workers—by our reckoning there are a record 30m unfilled vacancies across the OECD—which is hard to reconcile with the idea that people are no longer necessary. Wage growth for low-skilled workers, whose occupations are generally thought to be more vulnerable to replacement by robots, is unusually fast. There is still little evidence from America that “routine” jobs, thought to be easier to automate, are shrinking relative to other sorts of jobs.

Considering that so many doubts about the “robots kill jobs” narrative have arisen, it is not surprising that a different thesis is emerging. In a recent paper Philippe Aghion, Céline Antonin, Simon Bunel and Xavier Jaravel, economists at a range of French and British institutions, put forward a “new view” of robots, saying that “the direct effect of automation may be to increase employment at the firm level, not to reduce it.” This opinion, heretical as it may sound, does have a solid microeconomic foundation. Automation might help a firm become more profitable and thus expand, leading to a hiring spree. Technology might also allow firms to move into new areas, or to focus on products and services that are more labour-intensive.

A growing body of research backs up the argument. Daisuke Adachi of Yale University and colleagues look at Japanese manufacturing between 1978 and 2017. They find that an increase of one robot unit per 1,000 workers boosts firms’ employment by 2.2%. Another study, by Joonas Tuhkuri of the

Massachusetts Institute of Technology (MIT) and colleagues, looks at Finnish firms and concludes that their adoption of advanced technologies led to increases in hiring. Unpublished work by Michael Webb of Stanford University and Daniel Chandler of the London School of Economics examines machine tools in British industry and finds that automation had “a strong positive association with firm survival, and that greater initial automation was associated with increases in employment”.

Non-economists can be forgiven for rolling their eyes at the profession’s apparent about-face. But things are not as simple as saying that economists had got it wrong before. For a start, statistical methods have improved since the publication of the foundational papers in robonomics, such as one by Carl Benedikt Frey and Michael Osborne of Oxford University in 2013, which was widely interpreted as saying that 47% of American employment was at risk of automation. The methodology used by Mr Adachi and his co-authors is particularly clever. One problem is untangling causality: firms on a hiring spree may also happen to buy robots, rather than the other way round. But the paper shows that firms buy robots when their prices fall. This helps establish a causal chain from cheaper robots, to more automation, to more jobs.

| *The onrushing wave...of research*

A second qualification is that the “new view” does not establish that automation is “good”. So far, it has had little to say about job quality and wages. But a forthcoming book by David Autor, David Mindell and Elisabeth Reynolds of MIT finds that even if robots do not create widespread joblessness, they may have helped create an environment where the rewards are “skewed towards the top”. Others argue that automation reduces job quality.

Mr Aghion and his colleagues add that even if automation boosts employment at the level of the firm or industry, the effect across the

economy as a whole is less clear. In theory robot-adopting companies could be so successful that they drive competitors out of business, reducing the total number of available jobs. Such questions leave researchers with plenty more to investigate. But what seems clear at this stage is that the era of sweeping, gloomy narratives about automation is well and truly over. ■



自由交流

经济学家正在修正他们对机器人和就业的看法

没什么证据表明疫情引发了自动化的激增

疫情刚爆发时，失业率飙升。自大萧条以来，美国的失业率还没有像2020年4月那样冲到超过14%的高位。不过对高失业率长久持续的担忧并没有成真。根据现有的最新数据，去年11月，大部分由富裕国家组成的经合组织（OECD）的失业率仅略高于疫情前水平。到现在这个数字甚至可能已经降到与疫情前持平了。发达国家劳动力市场反弹这个最新现象再次促使经济学家重新审视自己学科的一个基本问题：机器人对劳动者是有害还是有害。

几十年来，“就业杀手”机器人的入侵近在咫尺的悲观叙事在大众的脑海里挥之不去。相当讽刺的是，警告人们未来可能要失业倒是给壮志在胸的公共知识分子创造了不少就业机会，他们或是出书，或是演讲。不过，在疫情爆发前不久，其他研究人员已经开始质疑这种流行观点。按说世界正在经历一场人工智能和机器学习的革命，但到2019年，发达经济体的就业率普遍升至历史高点。日本和韩国在使用机器人最多的国家之列，那里的失业率恰恰却是最低的。

许多人曾以为，这场疫情终于要证明末日预言家是对的。2020年年中，美国国家经济研究局（National Bureau of Economic Research）发表的一篇被广为引用的论文认为新冠疫情“可能会加速工作自动化”；另一篇论文则断言疫情“强化了自动化的趋势及影响”。国际货币基金组织（IMF）发表的一篇论文怀疑疫情期间失去的工作岗位能否“回归”。这些观点一部分基于这样的逻辑：既然机器人不会生病，老板们就会转而选择它们而非工人——之前有几次疫病大流行期间情况似乎就是这样。其他人指出，自动化的间歇性爆发往往发生在经济衰退期间。

但是，两年过去了，虽然全球投资支出正在飙升，与此同时却并没有发现多少自动化导致失业的证据。发达国家面临着劳动力短缺的问题——据我

们估计，整个经合组织未填补的岗位空缺达到创纪录的3000万个——这和不再需要人类劳动力的观点相矛盾。人们通常认为低技能岗位更容易被机器人取代，然而这类工人的工资增长异常迅速。在美国，仍然没什么证据表明高度重复性的“例行”岗位（一般认为这类工作更容易转向自动化）相对于其他岗位正在减少。

既然围绕“机器人扼杀就业”的说法出现了这么多疑点，一种不同的观点正在兴起也就不足为奇了。在近日发表的一篇论文中，来自法国和英国几家研究机构的经济学家菲利普·阿吉昂（Philippe Aghion）、席林·安东宁（Céline Antonin）、西蒙·比内尔（Simon Bunel）和泽维尔·贾拉维尔（Xavier Jaravel）提出了一个关于机器人的“新观点”，称“自动化的直接结果可能是在公司层面上增加就业，而不是减少就业”。这听上去可能像异端邪说，但它的确有坚实的微观经济学基础。自动化可能会让公司盈利更多，因此会扩大规模，也就会大举招人。技术也可能让公司能够转移到新的领域，或是专注于更加劳动密集型的产品和服务。

越来越多研究发现都支持这种观点。耶鲁大学的足立大辅和同事回顾了1978年到2017年之间日本制造业的情形。他们发现，每1000名工人对应的机器人数量每增加一台，公司的员工人数就会增加2.2%。麻省理工学院的约纳斯·图赫库里（Joonas Tuhkuri）和同事观察了芬兰的公司，结论是它们采用先进的技术后反而雇用了更多人。斯坦福大学的迈克尔·韦伯（Michael Webb）和伦敦政治经济学院的丹尼尔·钱德勒（Daniel Chandler）在一项尚未发表的研究中审视了英国工业中对机床的应用，发现自动化“与公司的生存有很强的正相关性，而且更高程度的初始自动化与就业增加有关”。

经济学家的态度看似发生了180度转向，外行人要给他们几个白眼也无可厚非。但并不能简单地说经济学家之前错了。首先，自机器人经济学的奠基性论文发表以来，统计方法已得到改进。这些论文之一在2013年发表，由牛津大学的卡尔·贝内迪克特·弗雷（Carl Benedikt Frey）和迈克尔·奥斯本（Michael Osborne）合著，被普遍解读为47%的美国就业人员面临被自动化取代的风险。足立大辅和合著者采用的方法特别精妙。研究的难

点之一是厘清因果关系：大举招兵买马的公司可能正好也会购入机器人，而不是反过来。但他们的论文表明，企业在机器人价格下降时购入它们。这就帮助确立了一条因果链：更便宜的机器人带来更程度的自动化，继而带来了更多就业。

| 研究大潮滚滚来

需要注意的第二点是，“新观点”并没有确定自动化就是“好的”。到目前为止它还没有揭示在工作岗位的质量和工资方面的影响。但在即将出版的一本新书中，麻省理工学院的大卫·奥特尔（David Autor）、大卫·明德尔（David Mindell）和伊丽莎白·雷诺兹（Elisabeth Reynolds）发现，即使机器人没有造成普遍失业，也可能帮助创建了一个奖励机制“向上层倾斜”的环境。其他人则认为自动化降低了岗位的质量。

阿吉昂和同事补充道，就算自动化在公司或行业层面上促进了就业，它对整个经济的影响也没那么明晰。理论上，采用机器人的公司可能非常成功，以致把竞争对手挤出市场，从而减少了就业机会的总量。这些问题留给了研究人员广阔的探究空间。但现阶段看起来已经明朗的一点是，有关自动化的普遍悲观论调彻底终结了。■



Chain reactions

Just how gummed up are supply chains?

A number of measures suggest that disruptions are historically high—and uncertainty lies ahead

THE GENERAL public learned far more about supply chains last year than it probably cared to. A host of disruptions to production and shipping interacted with soaring demand for goods to produce bare shelves and rising prices. Although goods have been in short supply, the number of measures tracking supply-chain woes has proliferated at an impressive pace in recent months. All paint a picture of historically high levels of disruptions, and an uncertain path ahead.

One gauge is an “ocean timeliness indicator”, published by Flexport, an American logistics firm. This reports how long it takes a shipment to move from the supplier’s warehouse to the departure gate of the destination port, for two big freight routes out of China: to Europe and America. Three years ago the journey to Europe took just under 60 days, and that to America just under 50. Travel times then rose steadily after the pandemic struck. But the trends for the two routes have diverged a little in recent months. Shipping times to Europe have fallen from above 110 days down to 108. Transport to America, at 114 days’ total journey time, takes longer than ever (see chart, top panel).

A global supply-chain pressures index, compiled from a variety of indicators by economists at the Federal Reserve Bank of New York, tells much the same story. Before the pandemic the highest-ever reading of the index (which the researchers have computed back to the 1990s) was in April 2011. Then, troubles associated with an earthquake and tsunami in Japan pushed the index up to 1.7 standard deviations above its long-run average. The measure surged much higher in spring 2020, to 3.9 standard deviations

above the mean; last year it rose even further still, reaching 4.4 in October. It has since retreated, but only by a touch, continuing to signal a high level of stress (see chart, bottom panel).

Another indicator, maintained by Capital Economics, a consultancy, takes account of both goods and labour shortages across the G7 group of large economies. It also suggests that stresses remained intense in late 2021. Freight rates, for their part, rocketed during the first nine months of 2021, before flattening off in the final quarter of last year. Yet as high rates become negotiated into longer-duration shipping contracts, elevated costs could persist into 2023 and beyond.

Whether and when matters improve depends on the course that both the virus and the global economic recovery now take. The appearance of the Omicron variant in parts of China could lead to lockdowns and further disruptions at ports. In America, a record number of covid-19 cases has meant that fewer longshoremen and truck drivers are in work. Hopes are dimming that a pause in production, associated with China's new year holiday in early February, might allow ports to work through existing backlogs.

Respite could come instead from cooling demand in the rich world, particularly in America, which in 2021 displayed a voracious appetite for all manner of goods. Analysts at Morgan Stanley, a bank, have constructed an indicator of supply-chain stress that looks at both supply and demand conditions. Their measure suggests that the latter are mainly responsible for the easing of pressures since late 2021. Trade growth has decelerated, for instance, thanks to reduced demand for both consumer and capital goods.

Flexport predicts that, although Americans' demand for goods relative to their appetite for services will remain unusually high in 2022, the imbalance should become less pronounced in the months ahead than it

was over the past year. If people start to hear a little less about supply-chain snarls, their own shifting shopping habits may explain why. ■



链式反应

供应链到底有多阻滞？

一批指标显示混乱程度处于历史高位，且前路仍不明朗

过去一年里，普通民众听闻的有关供应链的事可能远远超出他们关心的程度。生产和运输环节经受的各种干扰遇上商品需求飙升，导致货架空空，价格上涨。商品供应持续短缺之际，追踪供应链困境的各色指标在近几个月里倒是层出不穷。所有指标都表明，供应链混乱程度处于历史高位，而前路仍不明朗。

其中一个指标是美国物流公司Flexport发布的“海运时效指标”，报告在中国到欧洲和美国这两条主要货运路线上，货物需要多长时间从供应商的仓库抵达目的港的离港闸口。三年前，运抵欧洲只要不到60天，运抵美国不到50天。疫情爆发后，货运时长稳步攀升。但最近几个月这两条路线的趋势略微相互偏离。往欧洲的运输时间从110多天减少到108天。往美国的总运输时间则长达114天，比以往任何时候都更久（见图表上部）。

纽约联储的经济学家根据多种指标编制了一个全球供应链压力指数，也反映出大致相同的情况。在疫情爆发之前，该指数（研究者的统计回溯至1990年代）的最高值出现在2011年4月。当时，日本地震和海啸带来的麻烦将指数推至高于长期均值1.7个标准差。2020年春季，该指数更是大幅升至高于均值3.9个标准差；去年它又进一步上扬，到10月达到了4.4个标准差。此后虽有所回落，但幅度不大，表明供应链仍承受很高的压力水平（见图表下部）。

另一个由咨询公司凯投宏观（Capital Economics）运作的指标将大型经济体组织七国集团（G7）在商品和劳动力两方面的短缺纳入考量。该指标表明，2021年底的压力依然巨大。运费在2021年前九个月大幅飙升，在当年最后一个季度趋于平稳。然而，由于较长期的货运合同谈判中已经考虑了高运费，成本高企可能会持续到2023年甚至更久。

情况能否改善、何时改善，取决于当前疫情的发展和全球经济复苏的进程。中国部分地区出现了奥密克戎毒株，可能导致封锁并进一步扰乱港口作业。美国的新冠病例数创下新高，意味着在岗的码头工人和卡车司机减少。原本人们希望趁2月初中国春节期间生产暂停，港口也许可以消化掉积压的货物，但这种可能性变得越发渺茫。

反倒是富裕国家尤其是美国的需求降温可能带来一丝喘息的机会。2021年美国对各种商品都展现出旺盛的需求。摩根士丹利的分析师构建了一个衡量供应链压力的指标，同时反映供需两侧的状况。该指标显示，2021年底以来压力缓解主要是因为需求下降。例如，由于对消费品和资本品的需求减少，贸易增速已经放缓。

Flexport预测，尽管与服务需求相比，美国人对商品的需求在2022年仍将保持异常高的水平，但与去年相比，未来几个月里这种失衡应该会有所缓和。如果人们听到的有关供应链混乱的新闻开始变少了一些些，那可能是他们自身购物习惯的转变起了作用。■



In short supply

Why supply-chain problems aren't going away

Results season shows the financial effects of supply-chain snarl-ups on industrial firms

SUPPLY CHAINS have seldom featured in companies' earnings reports over the three decades since globalisation took off in earnest, save for the occasional mention of the benefits of low costs and lean inventories. This earnings season, though, covid-induced shortages are among the first problems mentioned by many firms. The Omicron variant has worsened the logjams by forcing workers, in many industries and the logistics business that weaves them together, to quarantine. And shortages of both staff and materials are contributing to inflation, raising costs across the board.

On January 25th disappointed investors sent GE's share price down by 6% after Larry Culp, the industrial icon's boss, said that supply-chain "headwinds" had hit its health-care business especially hard. Fourth-quarter revenues declined by 3.5%, year on year. On the same day Gregory Hayes, boss of Raytheon, presented mixed results, noting that the defence firm had "seen its share of supply disruptions". Others sniff trouble coming. On January 26th Boeing said that supply chains were not a "constraint" because its airliner production was low and inventories full. But, it added, raw materials, labour and logistical challenges were a "watch item". Hours later Tesla said supply-chain snags had forced it to run factories below capacity.

European firms are not immune. On January 21st Siemens Gamesa, a wind-turbine giant, blamed supply-chain woes for poor results and a profit warning. Vestas, a rival, has voiced similar concerns. EY, a consultancy, reckons that British-listed firms issued 19% more profit warnings in the last quarter of 2021 than a year earlier. A record number blamed supply-chain

disruption and rising costs.

Shortages are like nothing seen before (see chart). A chip crunch knocked nearly 10m units, or more than 10%, off annual car production in 2021 as firms slashed orders at the start of the pandemic and were pushed to the back of the queue when demand rebounded. Signs of improvement are scarce. Last month Toyota said that it would cut output by 150,000 vehicles, or around 18%, in February for a lack of chips. GE blamed part of its health-care arm's woes on the chip crunch. Large American firms surveyed by America's Commerce Department reported that their chip inventories had fallen from 40 days in 2019 to less than five days in 2021—and expected no improvement for at least the next six months. The department has warned that continuing shortages could force factories to close.

The transport of goods is not getting much freer, either. Container-shipping rates are creeping back up to the record levels of last summer. Analysts do not expect much relief before the second half of the year. Shortages of workers are making life harder still. IHS Markit, a consultancy, notes that America's labour force is 4m below pre-pandemic levels, Europe's has been disrupted by reduced movement of migrant workers and Asia's by strict new lockdowns. Raytheon blamed a tight supply of "castings", vital for jet-engine turbine blades, on a dearth of skilled welders. American Trucking Associations, a trade body, said last year that the industry faced a shortage of 80,000 lorry drivers.

These constraints are all adding to costs of parts, materials and wages. Throw in higher energy prices and industrial companies everywhere face a tough start to 2022. With all these obstacles showing little signs of disappearing, supply chains may well come high up the list of excuses if firms unveil disappointing quarterly results in a few months' time. ■



供应短缺

供应链问题为何迟迟未解

财报季显示出供应链阻塞对工业企业的财务影响

在全球化真正兴起后的30年里，公司的财报很少会谈及供应链，除了在偶尔提及低成本和精益库存的优势的时候。然而在这个财报季，新冠疫情引发的供应短缺成为许多公司提到的首要问题之一。奥密克戎毒株迫使许多行业以及连接各行各业的物流企业的工人接受隔离，令供应链阻滞雪上加霜。而劳动力和材料短缺也加剧了通货膨胀，使成本全面上涨。

1月25日，工业巨头GE的掌门人拉里·卡尔普（Larry Culp）表示供应链“逆风”尤其猛烈地冲击了公司的医疗业务。消息传来后投资者大失所望，公司股价应声下挫6%。第四季营收同比减少3.5%。就在同一天，国防公司雷神（Raytheon）的老板格雷戈里·海耶斯（Gregory Hayes）公布了喜忧参半的业绩，指出雷神也“遭受了供应中断的一些影响”。其他公司也察觉到麻烦将至。1月26日，波音表示供应链并未构成“制约”，因为它的客机产量较低，库存也充足。但它又补充说，原材料、劳动力和物流方面的挑战“值得关注”。几小时后，特斯拉表示，供应链阻滞导致其工厂不能满负荷生产。

欧洲公司也未能幸免。1月21日，风电设备制造巨头西门子歌美飒

（Siemens Gamesa）将糟糕业绩和利润预警归咎于供应链困局。其竞争对手维斯塔斯（Vestas）也表达了类似的担忧。咨询公司安永（EY）估计，英国上市公司在2021年最后一个季度发布的利润预警较去年同期增加了19%。将问题归结到供应链中断和成本上升的公司数量创下新高。

如此大规模的短缺可谓前所未见（见图表）。汽车生产商在疫情爆发之初减少订购芯片，到了需求反弹时只能排在队尾苦候，芯片不够用导致2021年汽车产量减少了近1000万辆，降幅超过10%。情况几乎没有改善的迹象。丰田在1月表示，由于芯片短缺，2月将减产15万辆汽车，降幅约为18%。通用电气将其医疗部门的困境部分归因于芯片短缺。美国商务部对

大型美国企业的调查显示，它们的芯片库存从2019年的40天减少到2021年的不足5天——而且预计至少未来六个月内不会改善。商务部警告说，持续短缺可能会迫使工厂停工。

货物运输也没有明显畅通起来的迹象。集装箱运价正缓慢回升至去年夏季的历史最高水平。分析师预计到今年下半年之前都不会明显缓解。劳动力不足也来火上浇油。咨询公司埃信华迈（IHS Markit）指出，美国就业人口数量较疫情前少了400万，欧洲的劳动力队伍受移民工人流动减少的影响，亚洲的则受制于新的严格封锁措施。雷神的“铸件”（生产喷气发动机涡轮叶片的关键部件）供应紧张，公司将原因归为熟练焊工短缺。行业团体美国货运协会（American Trucking Associations）去年表示，货运业缺八万名卡车司机。

这些制约因素都在推高零部件、原材料和工资的成本。再加上能源价格上涨，世界各地的工业企业在2022年都开局不顺。所有障碍几乎都没有消减的迹象，如果几个月后企业再公布令人失望的季度业绩，供应链很可能成为首当其冲的理由。■



Material moves

Commodities traders brace for a war in Ukraine

Tight markets mean that prices are all too responsive to rising tensions

“IF RUSSIAN TANKS cross the border, markets will freak out.” That is the considered judgment of Helima Croft, head of commodity strategy at RBC Capital Markets, an investment bank, and a former analyst at America’s Central Intelligence Agency. Were Russia to invade Ukraine, the biggest impact would first be felt on European gas markets. But Ms Croft is not alone in thinking that the shock waves would spread far more widely.

The potential for disruption stems from Russia’s huge importance for commodity markets (see chart 1). It is the world’s biggest exporter of natural gas, and the second-largest exporter of oil. It supplies nearly a tenth of the world’s aluminium and copper, and produces a range of other metals, including 43% of the world’s palladium, a component of catalytic converters. It is also the largest exporter of wheat.

The worst-case scenario is that the flow of these vital raw materials is cut off as tensions escalate. That could happen because Russian exports, or the payments infrastructure needed to facilitate them, are hit by Western sanctions. Alternatively, Russia could itself decide to halt some exports—notably of gas—in an attempt to cow its opponents.

The mere fear of disruptions has sent prices higher. On January 26th Brent crude oil approached \$90 a barrel, a seven-year high; the European benchmark for natural gas stood at about €90 (\$101) per megawatt hour, compared with €70 at the start of the year. The copper price is flirting with its multi-year peak.

The tightness of commodity markets makes prices all-too-sensitive to war

talk. During the global financial crisis of 2007-09 both global industrial production and commodity prices plunged in tandem, notes Macquarie, another bank. The pandemic, by contrast, has been accompanied by a surge in both manufacturing output and raw-material prices. Unexpectedly robust demand and supply-chain disruptions fuelled a 20% rise in the broad Bloomberg Commodities Index in 2021. The prices of a dozen of its elements, from cobalt and coffee to cotton and coal, shot up by even more.

Oil demand is roaring back towards pre-pandemic levels, even as supply has been slow to rise. Many members of the Organisation of the Petroleum Exporting Countries and its allies (which include Russia) are struggling to meet their quotas for increased production, because of under investment and covid-related complications. America's shale firms have discovered capital discipline, favouring investor returns over drilling. The result is that global spare production capacity is falling to precariously low levels. Spare capacity for many metals, too, is limited.

If war breaks out, the oil price could rise to \$120 a barrel, reckons Natasha Kaneva, head of commodities strategy at JPMorgan Chase, a bank. Ross Strachan of CRU, a consultancy, says aluminium prices could rise to all-time highs. The precedent for the impact of geopolitical tensions on prices is not exactly heartening. When America imposed sanctions on Rusal, Russia's largest aluminium producer, in 2018, prices of the metal were turbo-charged.

Russia and Ukraine together export about 29% of the world's wheat, and a big chunk of Ukrainian cultivation takes place in the regions that are most exposed to invasion. Carlos Mera of Rabobank, a Dutch firm, says withdrawing such volumes from the market would have an "extraordinary" impact, because the demand for wheat is so inelastic. Prices could easily double, he reckons. That would trigger a struggle to secure supplies, especially among the large importers of northern Africa and the Middle

East.

Some countries, such as China and Iran, might bypass Western sanctions and buy Russian metals and grains at discounted rates. That could in principle offer relief by satisfying some demand. But China and Iran together imported 17m tonnes of wheat last year, hardly a match for Russian and Ukrainian exports of 59m tonnes. Falling grain stocks in America and Europe and bad weather in South America threaten to starve the market further, says Geordie Wilkes of Sucden Financial, a broker. Moreover, Russia is a big producer of urea and potash, important ingredients for fertilisers. An export embargo would give grain prices a further leg-up.

For as long as tensions stay high, the pivotal role of energy in the economy means price rises will spill over to other markets, even if sanctions are not ultimately deployed. Expensive power has already caused some aluminium smelters to close in Europe. A surge in gas prices could cause more furnaces to shut down. It could also hit fertiliser production on the continent—for which gas is used as both raw material and fuel—hampering the next growing season.

If the tensions are resolved altogether, then it might be possible to imagine markets cooling off. Europe endured a natural-gas price shock last year, but a warm winter means that “a lot of angst has been taken out of the market, even though we still remain at very elevated price levels”, says Saad Rahim of Trafigura, a trading firm. But the tightness of supply means that prices will cool off only a bit. Ms Kaneva reckons that the risks with oil are asymmetric. If peace prevails, the oil price would merely drop to \$84 per barrel. But if war breaks out, “everything just goes up massively”. ■



重大波动

大宗商品交易商为乌克兰爆发战争做准备

市场吃紧导致价格对局势升级极为敏感

“俄罗斯的坦克一旦驶过边界，市场就疯了。”这是投行加拿大皇家银行资本市场（RBC Capital Markets）大宗商品策略主管、美国中情局前分析师赫里玛·克罗夫特（Helima Croft）深思后做出的判断。假如俄罗斯入侵乌克兰，首当其冲受到影响的将是欧洲天然气市场。但克罗夫特认为冲击将远不止于此，而且不止她有这样的看法。

动荡的前景源于俄罗斯在大宗商品市场上举足轻重的地位（见图表1）。它是世界上最大的天然气出口国，也是第二大石油出口国。它供应了全球近10%的铝和铜，还生产其他多种金属，包括供应量占全球43%的钯（用于催化转换器）。它也是最大的小麦出口国。

最坏的情况是，随着紧张局势升级，这些重要原材料的流动中断。如果俄罗斯的出口或出口所需的支付基础设施受到西方制裁的限制，可能就会发生这种情况。反过来，俄罗斯自己也可能决定暂停部分出口以遏制对手，特别是天然气的出口。

单单是对供应中断的担忧就已把价格送上高位。1月26日，布伦特原油价格接近每桶90美元，创下七年来新高；欧洲的天然气交易基准价格为每兆瓦时约90欧元（101美元），年初时仅为70欧元。铜价也正接近几年来的峰值。

大宗商品市场吃紧使得价格对战争言论的反应非常敏感。另一家投行麦格理（Macquarie）指出，在2007年至2009年全球金融危机期间，世界工业生产和大宗商品价格同步暴跌。而在新冠疫情期间，全球制造业产量和原材料价格都已飙升。意料之外的强劲需求和供应链中断推动了2021年彭博大宗商品指数整体上升20%。其中钴、咖啡，以至棉花和煤炭等十几种商品的价格甚至录得更高的涨幅。

石油需求急升，直奔疫情前水平，与此同时供应却回升缓慢。由于投资不足加上疫情引发的种种问题，欧佩克（OPEC）的许多成员及其盟国（包括俄罗斯）都难以完成增加的产量配额。美国的页岩油公司认识到了资本纪律的重要性，以投资者回报为先，钻探石油为次。结果就是全球石油备用产能低至岌岌可危的水平。许多金属的备用产能也相当有限。

如果爆发战争，油价可能升至每桶120美元，摩根大通的大宗商品策略主管娜塔莎·卡内娃（Natasha Kaneva）认为。咨询公司英国商品研究所（CRU）的罗斯·斯特罗恩（Ross Strachan）表示，铝价可能升至历史高位。从之前地缘政治紧张局势对价格的影响来看，情况并不乐观。2018年美国对俄罗斯最大的铝生产商俄铝（RUSAL）实施制裁，铝价因而急升。

俄罗斯和乌克兰合共出口了全球约29%的小麦，而乌克兰的小麦种植地很大一部分处于最易被入侵的地区。荷兰合作银行（Rabobank）的卡洛斯·梅拉（Carlos Mera）说，由于小麦需求的弹性很小，从市场上抽走这么多的供应会产生“非同寻常”的冲击。他认为很容易出现价格翻倍的情况。这将引发一场确保供应的争夺战，特别是在非洲北部和中东地区的大型进口商之间。

中国和伊朗等一些国家可能会绕过西方制裁，以折扣价购买俄罗斯的金属和谷物。这将满足部分需求，理论上能起到一定的纾缓作用。但去年中国和伊朗总共进口了1700万吨小麦，远赶不上俄罗斯和乌克兰总计5900万吨的出口量。券商苏克敦金融（Sucden Financial）的乔迪·威尔克斯（Geordie Wilkes）说，美国和欧洲的谷物库存下降，南美遭遇恶劣天气，都可能加剧市场供应短缺。此外，俄罗斯是化肥重要成分尿素和钾碱的生产大国。出口禁运将使谷物价格进一步上升。

能源是经济发展的关键，这意味着假如局势持续紧张，即使最终没有实施任何制裁措施，能源价格的涨势也会蔓延到其他市场。电价高企已导致欧洲一些炼铝厂关闭。天然气价格飙升可能让更多熔炉熄火，还可能打击欧洲大陆的化肥生产（因为天然气既是原料又是燃料），影响下一个种植季。

假如紧张局势完全平息，也许可以想象市场冷静下来。欧洲天然气价格去年经受了一次冲击，但这个暖冬意味着“尽管价格依然处于极高水平，市场焦虑已大大减轻”，贸易公司托克集团（Trafigura）的萨阿德·拉希姆（Saad Rahim）表示。然而供应紧张意味着价格只会稍微下降。卡内娃认为，油价风险是不对称的。如果局势趋向和平，油价只会下降至每桶84美元。而一旦爆发战争，“一切都会大幅上升”。■



In search of mastery

Can China create a world-beating AI industry?

Don't hold your breath

“SOUTH OF THE Huai river few geese can be seen through the rain and snow.” In classical Chinese this verse is a breakthrough—not in literature but in computing power. The line, composed by an artificial intelligence (AI) language model called Wu Dao 2.0, is indistinguishable in metre and tone from ancient poetry. The lab that built the software, the Beijing Academy of Artificial Intelligence (BAAI), challenges visitors to its website to distinguish between Wu Dao and flesh-and-blood 8th-century masters. Anecdotal evidence suggests that it fools most testers.

The system, whose name means “enlightenment” and which can emulate lowlier types of speech, derives its power from a neural network with 1.75trn variables and other inputs. GPT-3, a similar model built a year earlier by a team of researchers in San Francisco and deemed impressive at the time, considered just 175bn parameters. As such Wu Dao represents a leap in this type of machine learning, which tries to emulate the workings of the human brain. That delights fans of classical literature—but not as much as it does the Communist authorities in Beijing, which have put AI at the heart of China’s technological and economic master plan first set out in 2017. It spooks Western governments, which worry about AI’s less benign applications in areas like surveillance and warfighting. And it intrigues investors, who spy a huge business opportunity.

On the face of it, the plan is off to a good start. The logistics arm of JD.com, an e-commerce group, operates one of the world’s most advanced automated warehouses near Shanghai. In May Baidu, China’s search giant, launched driverless taxis in Beijing. SenseTime’s “smart city” AI models—urban surveillance cameras that track everything from traffic

accidents to illegally parked cars—have been deployed in more than 100 cities in China and overseas. China has been deploying more AI-assisted industrial robots than any other country. And in 2020 it surpassed America in terms of journal citations in the field.

The five most prominent listed Chinese AI specialists are collectively worth nearly \$120bn (see chart 1). The biggest of them, Hikvision, has a market value of \$60bn. SenseTime, which went public in Hong Kong on December 30th, is worth \$28bn. Two more are expected to list soon. In 2020 investments in unlisted AI startups reached \$10bn, according to the AI Index compiled by researchers at Stanford University. In its prospectus SenseTime forecasts that revenues from AI-assisted image-recognition and computer-vision software, the most mature part of the market, could hit 100bn yuan (\$16bn) by 2025, up from 24bn yuan in 2021 (see chart 2).

Look beyond the headlines or Wu Dao's elegant verses, however, and things look more complicated. Yes, China has made progress on AI, and even the occasional big splash like Wu Dao. But it almost certainly still lags behind America in terms of both investment and cutting-edge innovation. In 2020, three years into the master plan, privately held Chinese AI firms received less than half as much investment as their American counterparts. And a lot of the public and private money pouring into the sector may end up being wasted.

China's five-year-old AI master plan set out a number of goals. For example, by 2025 the country is to create an industry with global revenues of 400bn yuan, achieve "major breakthroughs" in technology and lead the world in some applications. Five years later it is to dominate the industry (by then worth \$1trn in sales), having written its ethical code and set its technical standards, just as Europe and America defined the contours of the Industrial Revolution.

Elements of the Communist Party's approach are characteristically prescriptive. The Ministry of Science and Technology has instructed China's tech giants with existing ventures in certain subdisciplines of AI—Tencent in medical image recognition, Baidu in autonomous driving—to double down on these. That said, the plan is less hands-on than some of the country's other development projects, observes Jay Huang of Bernstein, an investment firm. In the words of Huw Roberts of Oxford University and five co-authors, the blueprint acts chiefly as a “seal of approval” which “derisks” assorted AI initiatives championed by central-government entities, local authorities and the private sector.

In practice, the derisking involves doling out lots of public money. Some of this takes the form of tax breaks and subsidies, as in the “little giants” programme to nurture 10,000 promising startups across various sectors, including AI. Local governments, even in poor rustbelt provinces such as Liaoning in the far north-east, have also dangled similar incentives in front of AI-curious companies.

Another type of support comes from government procurement. Firms do not disclose how much revenue they derive from public-sector contracts. But the share is likely to be significant. Central and local authorities use SenseTime's surveillance technology. Megvii, which also specialises in image recognition, has extensive dealings with state-owned enterprises.

The state is also investing in AI companies directly. The central government runs several tech-investment vehicles. Local governments are increasingly creating their own, often armed with billions of dollars. Tianjin, a coastal metropolis, announced a \$16bn AI fund in 2018.

Government capital is increasingly helping plug a gap left by foreign investors scared away by American sanctions against some of China's AI darlings, which are seen as being too close to the Communist Party. A fund

run by the Cyberspace Administration of China, a regulator, has acquired an undisclosed stake in SenseTime, which in December was hit by another round of American sanctions over its alleged involvement in government repression of the Uyghur ethnic minority. (SenseTime says that the sanctions are based on a “misperception” of its business.) A separate vehicle, the Mixed-Ownership Reform Fund, accounted for \$200m of the \$765m that the firm raised in its initial public offering (IPO). Local governments chipped in another \$220m.

| *Lost in translation*

State dosh, combined with access to plentiful public data, has helped turn Chinese AI firms into powerhouses in certain niches. According to Bain, a consultancy, by last June the cloud division of Alibaba, China’s e-commerce behemoth, was offering 62 AI-enabled services, from voice recognition to video analytics, compared with 47 from its closest Western rival, Microsoft. SenseTime and Megvii mass-produce computer-vision software and hardware that can be adapted to and installed in individual factories. Despite being locked out of most Western markets by the American sanctions, SenseTime raked in 762m yuan in overseas revenues in 2020, compared with 319m yuan two years earlier, mostly from South-East Asia.

For all these successes, though, China’s AI industry trails the West in important ways. Despite leading America in the overall number of AI-related publications, China produces fewer peer-reviewed papers that have academic and corporate co-authors or are presented at conferences, both of which are typically held to a higher standard. It ranks below India, and well below America, in the number of skilled AI coders relative to its population. These shortcomings are likely to persist, for three reasons.

First, capital may not be being allocated efficiently. It is unclear, for example, how much of Tianjin’s \$16bn kitty has actually been deployed. More damaging, Beijing has created a system for rewarding local officials

that favours debt-fuelled spending and seldom punishes wastefulness.

Many state AI investments have been “reckless and redundant”, says Jeffrey Ding of Stanford University. Zeng Jinghan of Lancaster University has documented the rise of firms that falsely claim to be developing AI in order to suck up subsidies. One analysis by Deloitte, a consultancy, estimated that 99% of self-styled AI startups in 2018 were fake. Such boondoggles not only burn through public cash, Mr Ding notes, but also consume scarce human capital that could more usefully have been deployed elsewhere.

China’s second problem is its inability to recruit the world’s best AI minds, especially those working on high-level research. A study in 2020 by MacroPolo, a Chicago-based think-tank, showed that more than half of top-tier researchers in the field were working outside their home countries. America and Europe look more appealing to such footloose brainboxes, including many Chinese ones. Though about a third of the world’s top AI talent is from China, only a tenth actually works there. A shortage of non-Chinese researchers further handicaps China’s capabilities, notes Matt Sheehan of the Carnegie Endowment for International Peace, a think-tank in Washington.

Even more problematic for the party, its master plan ignored the cutting-edge semiconductors that power AI. Since its publication Chinese companies have found it ever more difficult to get their hands on advanced computer chips. That is because virtually all such microprocessors are either American or made with American equipment. As such, they are subject to restrictions on exports to China put in place by Donald Trump and extended by his successor as president, Joe Biden. It will take years for Chinese companies to catch up with the global cutting-edge, if they can do it at all.

These challenges will continue to bedevil all of China’s high-tech

industries for years to come. It could leave its AI businesses stuck in a rut—successfully rolling out relatively unsophisticated products while trailing Europe and America in paradigm-shifting developments of greater financial and strategic value. Consider Wu Dao 2.0. Although it was a huge improvement on GPT-3, it did just that—improve an existing technology rather than break new ground. No amount of Chinese taxpayers' money is likely to change that. ■



争当霸主

中国能否创建世界一流的AI产业？

别抱太大希望

“雨雪淮南雁迹稀。”这句用中国古文写成的诗是一次突破——不是在文学上，而是在计算能力上。这句诗在格律和声调上与古诗别无二致，但作者是一个名为“悟道2.0”的人工智能（AI）语言模型。开发该软件的实验室——北京智源人工智能研究院——请访客辨别自己网站上的诗哪些出自悟道，哪些出自八世纪的人类诗词大家。从粗略的结果看，悟道骗过了大多数参与测试的人。

悟道是“开悟启智”的意思，这个系统可以模仿一些较为简单的文体，这种本领来自一个有着1.75万亿个变量和其他输入的神经网络。一年前，旧金山的一个研究团队创建了类似的模型GPT-3，在当时被认为是一项令人赞叹的成就，不过只包含了1750亿个参数。因此，悟道代表了这种试图模仿人脑工作方式的机器学习技术的一次飞跃。这让古典文学爱好者欣喜。但更高兴的是中国共产党当局。2017年，中国首次提出以AI为核心的科技和经济发展总体规划。这让西方政府感到不安，它们担心AI被用于监视和战争等更不良善的用途。它也引起了投资者的兴趣，他们窥见了巨大的商机。

表面看来，这个规划的开局不错。电子商务集团京东的物流部门在上海附近运营着全球最先进的自动化仓库之一。去年5月，中国搜索引擎巨头百度在北京推出了无人驾驶出租车。商汤科技的“智慧城市”AI模型已在中国和海外的100多个城市部署，这种城市监控摄像头网络追踪从交通事故到非法停车的万事万物。中国已经和正在部署的AI辅助工业机器人数量位居世界第一。2020年，中国关于AI的学术文章被引用次数也超过了美国。

中国五家最著名的AI上市公司的总市值接近1200亿美元（见图表1）。其中最大的海康威视市值为600亿美元。商汤科技于去年12月30日在香港上市，目前市值280亿美元。预计还有两家公司很快也会上市。根据斯坦福

大学的研究人员编纂的AI指数，2020年，对未上市AI创业公司的投资达到100亿美元。商汤科技在招股书中预测，到2025年，AI辅助图像识别和计算机视觉软件这一AI市场中最成熟领域的收入将达到1000亿元，远高于2021年的240亿元（见图表2）。

然而，若让视线越过新闻头条和悟道的优雅诗句，眼前的景象就更加复杂了。确实，中国在AI方面取得了进展，甚至偶尔也有像悟道这样引人注目的重大成果。但几乎可以肯定的是，中国不管是在投资还是前沿创新方面仍然落后于美国。2020年，也就是上述发展规划实施的第三年，中国私营AI公司获得的投资还不到美国同类公司的一半。而且，大量涌入该领域的公共和私人资金最终也可能会被浪费。

中国的五年AI发展规划提出了一批目标。例如，到2025年，中国AI产业的全球收入将达到4000亿元，实现技术的“重大突破”，并在一些应用领域领先世界。五年后，它将主导该产业（届时整个行业的全球销售总额将达到一万亿美元），并为它制定了伦理准则和技术标准，就像欧洲和美国确立当年工业革命的骨架一样。

这一规划的要素带有中共典型的指令性做派。科技部已经指示在AI的某些分支领域有所投入的中国科技巨头加倍押注，比如腾讯在医疗图像识别领域，百度在自动驾驶领域等。即便如此，投资公司盛博的黄颀认为，与中国其他一些发展项目相比，这项规划没有那么多规定性。用牛津大学的休·罗伯茨（Huw Roberts）和其他五位论文合著者的话来说，这张蓝图主要起到“盖章批准”的作用，为中央政府机关、地方政府和私营部门支持的各种AI项目“消除风险”。

在实践中，消除风险需要投入大量公共资金。其中一些是以减税和补贴的形式，比如要在包括AI在内的各个领域培育一万家有前景的创业公司的“小巨人”计划。地方政府，甚至远在东北的辽宁等贫穷的老工业基地省份，也向有志于研发AI的企业推出了类似的激励措施。

另一种支持来自政府采购。各家公司没有披露自己从公共部门的合同中获

得了多少收入，但这一比例可能相当可观。中央和地方政府都使用商汤科技的监控技术。同样专攻图像识别的旷视科技也与许多国有企业有着广泛的业务往来。

政府还直接投资于AI公司。中央政府运营着好几家科技投资机构。越来越多的地方政府也在创建自己的科技投资工具，这些工具通常都配备数十亿美元的资金。2018年，沿海大城市天津宣布成立一只160亿美元的AI基金。

中国一些当红的AI公司被认为与共产党联系太紧密而遭到美国的制裁，吓跑了一些外国投资者，中国政府正不断加大注资以填补留下的缺口。监管机构国家网信办运营的一只基金已经收购了商汤科技的一些股份，具体数目未公开。去年12月，商汤科技因美国指责其参与政府压迫维吾尔少数民族而遭受美国的新一轮制裁。（商汤科技表示，这些制裁源于对其业务的“误解”。）在该公司IPO筹集的7.65亿美元中，另一个投资工具国有企业混合所有制改革基金贡献了2亿美元。另有2.2亿美元来自地方政府。

| 迷失在机器翻译中

政府资金，加上能够获得大量的公共数据，帮助中国AI公司成长为某些利基市场的大户。咨询公司贝恩称，截至去年6月，中国电商巨头阿里巴巴的云业务部门提供了从语音识别到视频分析等62种由AI驱动的服务，而相比之下，与它实力最接近的西方竞争对手微软只有47种。商汤科技和旷视科技批量生产的计算机视觉软件和硬件可以经调适安装在不同的工厂里。尽管美国的制裁把商汤科技隔绝在大多数西方市场之外，但2020年它的海外收入（主要来自东南亚）达到7.62亿元，而两年前这一数字为3.19亿元。

尽管取得了这些成功，但中国的AI产业在一些重要方面仍落后于西方。虽然中国发表的AI论文在总量上超过了美国，但其中由学术和企业作者共同撰写或在会议上展示发表的同行评议论文都较少，而这两类论文的要求通常更高。在熟练的AI程序员数量占全国人口的比例上，中国的排名低于印度，更远低于美国。这些短板可能会持续下去，原因有三。

首先，资本可能没有得到有效配置。例如，目前尚不清楚天津市160亿美元的资金实际部署了多少。更有害的是，中央建立的地方官员奖励制度助长举债支出，却很少惩罚铺张浪费。

斯坦福大学的丁磊表示，许多政府AI投资项目“草率又浪费”。兰卡斯特大学（Lancaster University）的曾敬涵举证了一些靠打着AI研发的幌子骗取补贴而发家的公司。咨询公司德勤的一项分析估计，2018年99%自封的AI创业公司都是“李鬼”。丁磊指出，这种无用功不仅烧光了公共资金，还消耗了本可以在其他地方更好发挥作用的稀缺人力资本。

中国的第二个问题是无法招募到世界上最优秀的AI人才，尤其是那些从事高水平研究的人才。芝加哥智库MacroPolo2020年的一项研究显示，AI领域超过一半的顶级研究人员都不在母国工作。对这些自由流动的天才来说，美国和欧洲看起来更有吸引力，这其中也包括很多中国人。尽管世界顶尖AI人才中约有三分之一来自中国，但真正在中国工作的只有十分之一。而缺乏非本国研究人员又进一步削弱了中国的研发能力，华盛顿智库卡内基国际和平基金会（Carnegie Endowment for International Peace）的马特·希恩（Matt Sheehan）指出。

对中国共产党来说，更大的问题是其发展规划忽视了驱动AI的尖端半导体技术。自规划公布以来，中国公司发现自己越来越难以获得先进的计算机芯片。这是因为几乎所有这类微处理器要么是美国制造的，要么是用美国的设备制造的。正因如此，特朗普将它们列入了对华出口管制清单，其继任者拜登又延续了这一举措。就算中国企业真的能赶上全球前沿技术，也还需要好多年。

未来几年，这些挑战将继续困扰中国所有的高科技产业。这可能会让中国的AI企业落入窠臼——可以成功推出相对简单的产品，但在具有更高金融和战略价值的范式变革上落后于欧洲和美国。悟道2.0就是这样。尽管它是对GPT-3的巨大改进，但也只是对现有技术的改进，而不是开辟了新天地。不管中国再花纳税人多少钱，都不太可能改变这一点。■



Battle of the blockchains

The race to dominate the DeFi ecosystem is on

Why Ethereum is losing market share

TO BELIEVERS, OPEN, public blockchains provide a second chance at building a digital economy. The fact that the applications built on top of such blockchains all work with each other, and that the information they store is visible to all, harks back to the idealism of the internet's early architects, before most users embraced the walled gardens offered by the tech giants. The idea that a new kind of “decentralised” digital economy might be possible has been bolstered over the past year as the numerous applications being built on top of various blockchains have boomed in size and functionality.

Perhaps the most significant part of that economy has been decentralised-finance (DeFi) applications, which enable users to trade assets, get loans and store deposits. Now an intensifying battle for market share is breaking out in this area. Crucially, Ethereum, the leading DeFi platform, seems to be losing its near-monopoly. The struggle shows how DeFi is subject to the standards wars that have broken out in other emerging technologies—think of Sony Betamax versus VHS video cassettes in the 1970s—and illustrates how DeFi technology is improving lightning-fast.

The idea behind DeFi is that blockchains—databases distributed over many computers and kept secure by cryptography—can help replace centralised intermediaries like banks and tech platforms. The value of assets stored in this nascent financial system has climbed from less than \$1bn at the start of 2020 to more than \$200bn today (see chart).

Until recently the Ethereum blockchain was the undisputed host of all this activity. It was created in 2015 as a more general-purpose version of Bitcoin.

Bitcoin's database stores information about transactions in the associated cryptocurrency, providing proof of who owns what at any time. Ethereum stores more information, such as lines of computer code. An application that can be programmed in code can be guaranteed to operate as written, thereby removing the need for an intermediary. But just as Ethereum improved upon Bitcoin, it too is now being usurped by newer, better technology. The fight resembles competition between operating systems for computers, says Jeremy Allaire, the boss of Circle, a firm that issues USD Coin, a popular crypto-token.

Current blockchain technology is clunky. Both Bitcoin and Ethereum use a mechanism called "proof of work", where computers race to solve mathematical problems to verify transactions, in return for a reward. This slows the networks down and limits capacity. Bitcoin can process only seven transactions per second; Ethereum can handle only 15. At busy times transactions are either very slow or very costly (and sometimes both). When demand to complete transactions on Ethereum's network is high, the fees paid to the computers that verify them climb and settlement times grow. Your correspondent has paid as much as \$70 to convert \$500 into ether and waited for several minutes for a transfer from one crypto-wallet to another to take place.

Developers have long been trying to improve Ethereum's capacity. One prong of that is, in effect, rewiring it. Plans are afoot to shift Ethereum to a more easily scalable mechanism called "proof of stake" later this year. Another idea is to split the blockchain up, through a process called "sharding". The shards will share the load, expanding capacity. Some developers are also working on ways to bundle transactions, reducing the number of them that must be directly verified.

The problem is that each advance comes with costs. DeFi's supporters tout the virtue of being able to conduct transactions securely and without

centralised intermediaries. But gains in scale could come at a price, by making the platform less secure, or less decentralised. Pooling transactions before they reach the blockchain tends to be done by centralised entities. And it might be easier for hackers to attack a single shard of a blockchain than the entire thing. As a result, Ethereum developers have been slow to make changes.

This sluggishness has made the network vulnerable in a different way—by encouraging rivals. In early 2021 nearly all of the assets locked in DeFi applications were on Ethereum's network. But in a recent research note JPMorgan Chase, a bank, estimates that the share of DeFi applications using Ethereum fell to 70% by the end of 2021. A growing number of networks, such as Avalanche, Binance Smart Chain, Terra and Solana, now use proof of stake to run blockchains that do the same basic job as Ethereum, but much more quickly and cheaply. Avalanche and Solana, for instance, both process thousands of transactions a second.

The experience of USD Coin illustrates these shifts. The token was launched on Ethereum just over three years ago, but has since been launched on a number of competitor networks, including Algorand, Hedera and Solana. Mr Allaire says that whereas transactions on Ethereum are subject to cost and speed limitations, those on Solana can handle "Visa-scale volumes" with "settlement finality in about 400 milliseconds and a transaction cost of about a twentieth of a penny". Other DeFi applications, like SushiSwap, an exchange founded on Ethereum, have also launched on several other blockchains.

With the planned changes to Ethereum likely to take at least a year, if not longer, "the risk is that...the Ethereum network will lose further market share", wrote Nikolaos Panigirtzoglou of JPMorgan. For Mr Allaire, the picture is pleasingly competitive: "Just like with the web, where Windows, iOS and Android all compete, there are competing blockchain platforms,

too.” He thinks the ultimate victor will be the platform that attracts the best developers to build applications and therefore reaps network effects.

But the operating-system metaphor may only extend so far, in part because of the nature of open, public blockchains. Anyone can access the data they produce and view their operating code, making it possible to build bridges or applications that work across many blockchains, or which aggregate information from different blockchains. Some applications, like 1inch, already scan exchanges on several blockchains in order to find the best execution prices for various crypto transactions. “Multi-chain” blockchains, like Polkadot and Cosmos, act like bridges between different networks, making it possible to work across them.

For as long as decentralised finance holds promise, competition to be the network of choice will naturally be fierce. But the idea that the eventual winner will take everything, gaining overall control over the digital economy and how it develops, may one day come to seem as outdated as the video cassette. ■



区块链之战

DeFi生态系统争霸战开启

以太坊为何逐渐失去市场份额

开放的公共区块链为打造数字经济提供了第二次机会，它的信徒如此认为。基于这类区块链的应用能相互兼容协作，而且存储其中的信息对所有人公开可见，这让人想起早期互联网设计师的理想主义，当时大多数用户都还没走入科技巨头筑起的围墙花园。过去一年，随着基于各类区块链的众多应用的规模扩大、功能增强，人们越发有理由相信，一种“去中心化”的新型数字经济也许是可以实现的。

这种经济中最重要的部分或许是帮助用户交易资产、贷款和存款的去中心化金融（DeFi）应用。一场激烈的市场份额争夺战正在该领域爆发。关键是，领先的DeFi平台以太坊近乎垄断的地位似乎不保。这番争夺表明DeFi会像其他新兴技术一样爆发标准之争（如上世纪70年代的索尼Betamax与VHS录像带的格式之战），也显示出DeFi技术正如闪电般高速改进。

DeFi背后的理念是，区块链（分布在许多计算机上的数据库，通过加密技术保障安全）能帮助取代银行和科技平台等中心化中介。在这一新生金融系统中储存的资产价值已从2020年初的不到十亿美元攀升至如今的2000多亿美元（见图表）。

直到最近，以太坊区块链都还是所有这类活动当仁不让的主场。2015年创建的以太坊相当于更通用版本的比特币。比特币数据库存储相关加密货币的交易信息，能证明谁在什么时间拥有什么资产。以太坊存储的信息更多，包括计算机代码。一个用代码编程的应用可以保证会按代码运行，也就不再需要中介。但正如以太坊超越了比特币那样，更新更好的技术也在篡夺以太坊的地位。发行流行加密代币USD Coin的Circle公司老板杰里米·阿莱尔（Jeremy Allaire）说，眼下这场斗法就像当年的计算机操作系统之争。

目前的区块链技术仍然粗陋难用。比特币和以太坊都采用名为“工作量证明”的机制，由计算机竞相解决运算难题以验证交易并换取奖励。这拖慢了系统的速度，也限制了容量。比特币每秒钟只能处理七笔交易，以太坊只能处理15笔。繁忙时，交易不是慢就是贵，有时还既慢又贵。当以太坊网络的交易完成需求高涨时，计算机的交易验证费用就会攀升，交易结算耗时也会变长。笔者把500美元转换成以太币就支付了高达70美元的费用，在不同加密钱包之间转账也等了好几分钟。

开发人员一直想给以太坊扩容。其中一个方式实际上就是完全改变系统的运作机制。正在推进的计划包括在今年晚些时候让以太坊转向更易扩展的“权益证明”机制。另一个方案是通过名为“分片”的技术为区块链分区。这些分片链将分担负载，扩大容量。也有开发者在研究通过捆绑交易来减少必须直接验证的交易数量。

问题是每种改进都有其成本。DeFi的拥趸大谈无需中心化中介就能安全交易的优点。但扩容可能要付出代价，会降低平台的安全性或去中心化的程度。在上传至区块链之前聚合交易的这一步往往由中心化的实体完成。而且，单个分片链可能比整个区块链更易受黑客攻击。出于这些顾虑，开发人员对以太坊的改进进展缓慢。

改进缓慢促进了对手平台的成长，结果从侧面削弱了以太坊。在2021年初，几乎所有放在DeFi应用里的资产都在以太坊的网络上。但据摩根大通最近的一份研究报告估计，到2021年底，以太坊上DeFi应用的资产份额已降至70%。现在，雪崩协议（Avalanche）、币安智能链（Binance Smart Chain）、Terra和Solana等越来越多网络通过权益证明机制运行区块链，不但能实现以太坊的基本功能，而且速度快得多，成本低得多。例如，雪崩协议和Solana都能在一秒内处理数千笔交易。

USD Coin的发展历程体现了这些转变。该代币三年多前才在以太坊上推出，但之后已在一些对手网络上推出，包括Algorand、Hedera和Solana。阿莱尔指出，在以太坊上，交易受制于成本和速度，而Solana可以承担“Visa级别的交易量”，“可以在约400毫秒内完成结算，交易成本约为二十

分之一分钱”。其他DeFi应用（如在以太坊上创建的交易所SushiSwap）也已在其他几个区块链网络上推出。

以太坊计划中的升级改造可能至少要花一年时间，“风险是.....以太坊网络将进一步失去市场份额。”摩根大通的尼克拉奥斯·潘尼吉兹格鲁（Nikolaos Panigirtzoglou）写道。阿莱尔则乐见这一竞争局面：“就像互联网上有Windows、iOS和安卓相互争夺一样，区块链也要有相互竞争的平台。”他认为，最终的胜者会是能吸引最优秀开发人员来构建应用从而收割网络效应的平台。

但与操作系统的相似之处可能仅此而已，原因之一是开放式公共区块链的性质。任何人都可以访问这些区块链生成的数据，查看其操作代码，从而可能在众多区块链网络之间搭建桥梁或应用，也可以从不同的区块链聚合信息。1inch等一些应用已经可以扫描多个区块链上的交易所，为各种加密货币交易寻找最佳执行价格。Polkadot和Cosmos等“多链”区块链则在不同网络间发挥桥梁的作用，令跨网络运作成为可能。

只要去中心化金融继续展现潜力，成为头号区块链网络的竞争必然会很激烈。但如果认为最后会是赢者通吃、全面掌控这一数字经济及其发展方向，这样的想法可能终有一天会像录像带一样过时。■



The future of technology

Big tech's supersized ambitions

From metaverses to quantum computing

IS THERE ANY limit to the ambition and hubris of big tech firms? In October Mark Zuckerberg renamed Facebook Meta and described humankind's new future in virtual worlds. On January 18th Microsoft, worth more than \$2trn, decided it wasn't big enough and bid \$69bn for Activision Blizzard, a video-games firm, in its biggest-ever deal. These decisions are part of a vast new investment surge at five of America's biggest firms, Alphabet, Amazon, Apple, Meta and Microsoft—call them MAAMA. Together, they have invested \$280bn in the past year, equivalent to 9% of American business investment, up from 4% five years ago.

Big tech wants to find the next big opportunity, and our analysis of deals, patents, recruitment and other yardsticks shows that cash is flowing into everything from driverless cars to quantum computing. The shift reflects a fear that the lucrative fiefs of the 2010s are losing relevance, and the fact that tech's titans are increasingly moving onto each other's patches (the share of sales that overlap has doubled since 2015 to 40%). So they are all looking to swoop into new territory.

They also have an eye on the history of technology, which is littered with once-dominant firms that were brought down not by regulators, but by missing the next big thing. Fairchild Semiconductor ruled in the 1950s but now exists only in books. In 1983 IBM was America's most profitable firm but eight years later was loss-making after botching the move from mainframes to PCs. Nokia, once seemingly invincible in mobile devices, fumbled the shift to smartphones. The MAAMAs spent the 2010s fortifying commanding positions, in business tools for Microsoft, e-commerce for Amazon, social media for Meta, and so on. The pandemic has boosted

demand, from bored couch-surfers to startups in need of cloud computing. Apple and Alphabet are now larger than were US Steel and Standard Oil, the two mighty monopolies of the 1900s, measured by profits relative to domestic GDP. Yet past performance is not indicative of future results, and now all of them are limbering up for whatever comes next.

The problem is that nobody knows what it will be. But it will probably involve new physical devices that will supersede the smartphone as the dominant means of connecting people to information and services. Whoever makes such devices will therefore control access to users. This explains why Apple is planning a virtual-reality headset to compete with Meta's Oculus range and Microsoft's HoloLens. Alphabet, Apple and Amazon have also all placed expensive bets on autonomous cars. And vast sums are being spent on designing specialised chips, and pursuing new approaches like quantum computing, to provide the processing power for whatever new devices emerge.

The MAAMAs' other priority is creating software platforms that will allow them to extract rents, by drawing in users, and then relying on network effects to draw in even more. Hence Facebook's renaming and its \$10bn annual spending on immersive online worlds, known as the metaverse. Apple has been expanding the walled garden of services it provides to users of its devices, moving into areas such as fitness classes and television shows. Buying Activision may help Microsoft provide a richer experience for its gaming customers, while Mesh, a platform for virtual 3D workplaces, is aimed at corporate users. The cloud-computing platforms operated by Alphabet, Amazon and Microsoft literally charge rent to host computing environments for other companies.

Governments, rivals and billions of customers, who already fear these firms are too powerful, may be alarmed by all this. One view is that the companies' large customer bases, and control of pools of data with which

to train artificial intelligence (AI), give them an insurmountable advantage. Won't the giants use that to squash rivals? Yet all these new areas look competitive for the time being. Many other firms are in the metaverse race, for example. "Fortnite", made by Epic Games, has more than 300m players worldwide, while Roblox has 47m gamers who spend 3bn hours a month on its platform. Nvidia, a chip firm, is moving into the space, too. Even Microsoft's Activision deal would raise its market share in gaming to only 10-15%—hardly a monopoly. In autonomous cars, big tech must contend with the likes of Tesla, GM and Volkswagen. Global startups raised \$621bn of venture funding in 2021, far more than big tech invested. And new rivals have emerged with unexpected speed in some areas, such as TikTok in social media.

Moreover, there is an outside chance that the new terrain will prove less prone to domination by centralised platforms. Deep-learning technology, the dominant form of AI today, relies on large amounts of data, but future forms of AI may not. Then there are the decentralised blockchain services owned and operated by users, loosely known as Web3. At the moment these have clunky interfaces, use up lots of energy and are not always as decentralised as they seem. But in one area—decentralised finance, or DeFi—rapid improvements are already under way.

Nonetheless, the temptation is for regulators to clamp down pre-emptively. In 2020 Lina Khan, who is now America's top antitrust official, recommended that big tech firms be banned from expanding into adjacent areas. Some big antitrust cases may reach America's courts by 2023. And Europe may soon pass a sweeping Digital Markets Act, aimed at regulating big technology companies "ex ante"—that is, constraining such firms' behaviour upfront, rather than punishing them later with antitrust cases.

Yet a lighter touch is the best policy. Investment in tech is linked to rising productivity, and the share of cashflows the tech giants are reinvesting has

almost doubled since a decade ago. Trustbusters will struggle to predict the technologies of tomorrow. What they can do is block firms from doing deals that give them a monopoly position in new markets today. That is not yet a danger. Indeed, history suggests that tech giants are most often brought down by failing to master emerging technologies. If today's giants want to spend billions trying to move into new areas to avoid that fate, so far there is no reason to stop them. ■



【首文】科技的未来

大型科技公司的超大号野心

从元宇宙到量子计算

大型科技公司的野心和傲慢还有边际吗？去年10月，马克·扎克伯格将Facebook更名为Meta，并描绘了人类在虚拟世界的全新未来。市值超过2万亿美元微软认为自己还不够大，于1月18日出价690亿美元收购电子游戏公司动视暴雪（Activision Blizzard），这是它有史以来最大一笔交易。这些决策是美国最大的五家公司新一轮投资大潮的一部分，这五家公司是Alphabet、亚马逊、苹果、Meta和微软，姑且称它们为MAAMA。过去一年，它们总共投资了2800亿美元，相当于美国商业投资的9%，五年前这个数字是4%。

大型科技公司希望能找到下一个重大机遇。我们对交易、专利、招聘等衡量标准的分析表明，现金正流入从无人驾驶汽车到量子计算的各个领域。这种转变反映出企业担心在2010年代利润丰厚的领域正渐渐过气，也反映出科技巨头们越来越多地闯入了彼此的地盘（自2015年以来它们销售中重叠部分的占比翻了一番，达到40%）。因此它们都在寻找机会杀进新领域。

它们还留意起科技的历史来，提醒自己有大量曾经占据主导的公司并不是被监管机构拉下马，而是因为错过了下一个大事件而地位不保。飞兆半导体（Fairchild Semiconductor）在上世纪50年代风头无两，现在却只存在于书本中。IBM在1983年是美国最赚钱的公司，但它在从大型主机到个人电脑的转型中失败，八年后开始亏损。诺基亚在移动设备领域曾看似所向无敌，在转向智能手机的过程中却方寸大乱。MAAMA在2010年代巩固了各自的统领地位：微软在商业工具领域，亚马逊在电子商务，Meta在社交媒体，等等。从无聊的沙发冲浪者到需要云计算的创业公司，疫情提振了需求。以利润相对于本国GDP之比来衡量，苹果和Alphabet现在比美国钢铁公司（US Steel）和标准石油（Standard Oil）这两个1900年代的垄断巨头还要大。但既然过往表现并不能预测未来成绩，这些公司如今都在为接

下来的局面做准备。

问题是没人知道接下来会是什么局面。但未来很可能会用到新的实体设备，取代智能手机成为连接人与信息和服务的主要手段。因此，不管是谁，只要能制造出这样的设备，就将掌控获取用户的渠道。这就解释了为什么苹果正规划推出一款虚拟现实头显，要与Meta的Oculus系列和微软的HoloLens竞争。Alphabet、苹果和亚马逊也都在无人驾驶汽车上押下重注。此外还有大量资金被用于设计专用芯片以及探索量子计算等新方法，要为未来的新设备提供处理能力。

MAAMA的另一个优先事项是创建软件平台，让它们能通过吸引用户来抽租，然后再靠网络效应吸引更多用户。为此，Facebook改了名字，并每年斥资100亿美元打造沉浸式网络世界，即元宇宙。苹果一直在扩建为自家设备的用户提供服务的“封闭花园”，涉足健身课程和电视节目等领域。收购动视可能有助微软为自己的游戏客户提供更丰富的体验，而它的虚拟3D工作协作平台Mesh则面向企业用户。Alphabet、亚马逊和微软运营的云计算平台其实就是在向其他公司收取托管计算环境的租金。

这一切可能会让政府、竞争对手和数十亿客户警觉起来，他们本来就已经在担心这些公司太过强大了。一种观点认为，这些公司拥有庞大的客户群，控制着可用以训练人工智能（AI）的数据池，这赋予了它们不可撼动的优势。这些巨头难道不会利用这种优势来碾压对手？然而，这些新领域目前看起来都还充满竞争。例如，其他许多公司已投身于元宇宙的竞赛中。由Epic Games制作的《堡垒之夜》在全球拥有超过3亿玩家，而Roblox的4700万玩家每个月在它的平台上花费长达30亿小时。芯片公司英伟达也在进军这个领域。即使收购了动视，微软在游戏市场的份额也只会提高到10%到15%——远说不上垄断。在无人驾驶汽车领域，科技巨头们必须与特斯拉、通用汽车和大众等公司竞争。2021年，全球创业公司吸引了6210亿美元的风险投资，远超过大型科技公司的投资额。在某些领域，新的竞争对手以出人意料的速度崛起，比如社交媒体领域的TikTok。

此外还存在一线希望：这些新领域最终不太容易被中心化平台统领。如今

AI的主导形式是深度学习技术，它依赖大量的数据，但未来的AI形式可能不会这样。此外还有由用户所有和运营的分散的区块链服务，大致可以称作Web3。目前它们的界面还不太好用，且耗能很大，也并不总是像看起来那样去中心化。但在去中心化金融（DeFi）这个领域，情况已在迅速改善。

尽管如此，监管者还是会忍不住想要先发制人、重拳出击。现任美国最高反垄断官员莉娜·汗（Lina Khan）在2020年建议禁止大型科技公司向邻近的领域扩张。一些大型反垄断案件可能会在2023年前在美国的法院开审。欧洲可能很快会通过一项全面的《数字市场法案》（Digital Markets Act），旨在“事前”监管大型科技公司，也就是事先约束这些公司的行为，而不是在事后用反垄断诉讼来惩罚它们。

然而，最好的对策还是下手轻一点。对科技的投资与生产率提高相关联，而且自十年前以来，科技巨头们用于再投资的现金流份额几乎翻了一番。反垄断官员将很难预测技术的未来。他们能做的就是阻止企业进行能让它们在现如今的新市场上获得垄断地位的交易。现在倒还没有这方面的危险。事实上，历史表明，科技巨头最常因未能掌握新兴技术而倒下。如果今天的巨头想砸数十亿奋力打入新领域以避免这种命运，目前来看不如随它们去。 ■



Climate change

A lot of Arctic infrastructure is threatened by rising temperatures

Russia will be particularly badly hit

A QUARTER OF the northern hemisphere's land is covered by permafrost, defined as ground that remains at or below 0°C for at least two years in succession. Most of this is above the Arctic Circle, a part of the world that is warming at a rate double the global average, with significant consequences for the rest of the planet. Arctic permafrost is thought to contain some 1.7trn tonnes of carbon, most of it in frozen organic matter. That is double the amount of the stuff currently residing in the atmosphere. Rising temperatures mean that much of this material may turn into carbon dioxide and methane as the ground thaws and micro-organisms get to work. That will drive further warming, causing a feedback loop of more melting and yet more greenhouse-gas emission.

These risks are re-emphasised in a paper just published in Nature Reviews Earth and Environment. It warns that warming of the top three metres of permafrost alone could result in the release of 624m tonnes of carbon a year by 2100, a figure similar to the current emissions of Canada or Saudi Arabia. But a thawing Arctic poses other, more immediate, problems. Another paper published in the same journal highlights the threat posed to circumpolar infrastructure as the ground beneath it thaws.

Thawing permafrost is a particularly unpredictable environment on which to build. As its ice content changes and the volume of liquid water increases, the soil can experience vertical movements of up to 40cm a year and its capacity to bear weight drops dramatically. This can lead to landslides, to the subsidence of individual buildings, and to the appearance of cracks and deformities in long, linear structures such as roads and pipelines.

The conclusions drawn by lead author Jan Hjort, of the University of Oulu, in Finland, are stark. Of the 120,000 buildings, 40,000km of roads and 9,500km of pipelines currently built on permafrost, up to half are expected to be at high risk by 2060. By then, he estimates, the bill for maintenance could exceed \$35bn dollars a year.

Russia is the country most threatened by such changes. Almost 65% of Russian soil is permafrost, and it is here that 60% of the Arctic's human settlements and almost 90% of its population can be found (see maps). Russian sites are also more likely than those in other parts of the Arctic to contain heavy apartment buildings and large industrial facilities. North America's permafrost, which makes up half of Canada's territory and more than three-quarters of Alaska's, tends to be more sparsely populated than Russia's, with human impact dominated by roads, airstrips and oil pipelines. Nonetheless, degradation is still an issue. Authorities in the Northwest Territories, one of Canada's largest and most northerly regions, calculate that permafrost-induced damage amounts, even today, to \$41m a year, which is about \$900 per resident.

Dr Hjort's paper also looks at the Arctic conditions which prevail in mountainous regions at lower latitudes. Nearly half of the Tibetan plateau, for example, is covered by permafrost, and this area contains 200,000km of roads and 3,900km of railways. The cost of repairs here runs into the tens of millions of dollars a year. In the European Alps, by contrast, a combination of higher investment and more favourable conditions mean thaw damage is minimal.

Dr Hjort and his colleagues suggest three approaches to increasing resilience, some of which have already been implemented to various extents in different Arctic locations. First, enhance the extraction of heat from thawing soil near structures which need protecting. This can be done by adding porous stone layers to road beds to generate convection, which

helps hot air to escape. Decreasing the angle of embankment slopes also helps, by increasing wind flow and reducing the accumulation of snow, which traps heat. Second, limit heat intake by the ground. This means insulating the embankments of roads by increasing their thickness, and also increasing the reflectivity of paved surfaces to minimise the amount of solar radiation absorbed. Third, the ground can be reinforced to create better foundations. One way to do so is to replace layers of permafrost with more stable materials. Another is to thaw the permafrost in a controlled manner, and then build on that consolidated layer.

None of this innovative construction will help, however, if there is a lackadaisical approach to maintaining what has been built. In an earlier study cited by the authors, which looked at the period from 1980 to 2000, most damage to structures in areas of Russia where permafrost abounds was found to have arisen as a result of poor maintenance. Climate change will make that worse. But if local authorities cannot even get the basics right, then large sections of the Russian Arctic may end up being abandoned altogether. ■



气候变化

北极的许多基础设施受到气温上升的威胁

俄罗斯更是会遭受重创

北半球四分之一的土地上覆盖着永久冻土层，也就是至少连续两年温度保持在 0°C 或以下的地面。永冻层大部分位于北极圈以内，而这一地区的变暖速度是全球平均水平的两倍，这就将给地球其他地区带来严重影响。据推断，北极的永久冻土层含有约1.7万亿吨碳，其中大部分是冰冻的有机物。这个数量是目前大气中含碳量的两倍。气温不断上升意味着，随着地面解冻和微生物开始发挥作用，这些物质中的大部分可能会变成二氧化碳和甲烷。这将导致气候进一步变暖，融化更多冻土，释放出更多温室气体，形成恶性循环。

刚刚发表在《自然综述：地球与环境》（Nature Reviews Earth and Environment）上的一篇文章再次强调了这些风险。它警告说，到2100年，光是近地表三米的永久冻土变暖就可能每年释放6.24亿吨碳，相当于加拿大或沙特阿拉伯一国目前的排放量。但是融化中的北极还带来了其他更紧迫的问题。同一期刊上发表的另一篇文章强调了冻土融化给它上面的基础设施带来了威胁。

建造在逐渐融化的永冻土之上的建筑的处境难以预测。随着冰含量的变化和液态水的增加，土壤每年可能经历多达40厘米的垂直运动，其承重能力会急剧下降。这可能会导致山体滑坡、个体建筑物沉降，还会让道路和管道等长条构造出现裂缝和变形。

该文第一作者芬兰奥卢大学（University of Oulu）的扬·约尔特（Jan Hjort）得出的结论是严峻的。目前有12万栋建筑、4万公里的公路和9500公里的管道修建在永久冻土上，预计到2060年其中多达一半都将面临高风险。他估计，到那时每年的维护费用可能超过350亿美元。

俄罗斯是受这些变化威胁最大的国家。俄罗斯65%的领土是永久冻土，而

北极地区60%的人类居住地和近90%的人口都集中在这里（见地图）。和北极其他地区相比，俄罗斯的这些地区也更有可能建造沉重的公寓楼和大型工业设施。加拿大领土的一半、阿拉斯加的超过四分之三都处于北美的永冻层，这里与俄罗斯的永冻层相比往往人口更稀少，对人类的影响主要集中在道路、飞机跑道和石油管道上。尽管如此，冻土融化仍然是个问题。西北领地（Northwest Territories）是加拿大面积最大、最靠北的地区之一。据当地政府计算，即使在今天，冻土融化造成的损失就已高达每年4100万美元，相当于每个居民900美元。

约尔特的论文还研究了在较低纬度的山区分布广泛的极地环境。例如，青藏高原的近一半被永久冻土层覆盖，这一地区有20万公里的公路和3900公里的铁路，每年的维修费用达数千万美元。相比之下，在欧洲的阿尔卑斯山脉，更多的投资加上更有利的地质条件意味着冻土融化的破坏最小。

约尔特和同事提出了三种提高适应性的方法，其中一些已经在北极不同地区以不同程度实施。首先，从需要保护的建筑物附近的解冻土壤中提取更多热量，方法可以是在路基上增加多孔的石头层来产生对流，帮助热空气排出。缩小路堤护坡的角度也有帮助，因为这可以增加风量，减少积雪，从而避免热量积累。第二，限制地面吸收的热量。也就是说增加路堤的厚度来隔热，并且加大铺筑路面的反射率，最大限度地减少地面吸收的太阳辐射。第三，加固土层以夯实地基。一种方法是用更稳固的材料替换永久冻土层。另一种是以一种可控的方式融化冻土，然后在压实的土层上建造设施。

但是，如果对维护已建成的设施漫不经心，那么这些创新的建筑方法全都无济于事。作者引用的一项早前的研究发现，1980年到2000年间，在俄罗斯永冻层集中的地区，大多数建筑物的损坏是因为本身维护不善。气候变化会让这种损坏恶化。但如果当地政府连最基础的工作都做不好，那么俄罗斯位于北极的大片地区可能最终会完全废弃。 ■



Buttonwood

The faster metabolism of finance, as seen by a veteran broker

Prices are set at the margin. And the marginal trader is a hedge-fund manager

A FEW YEARS ago a stranger sidled up to me at a conference. I had been introduced as an equity salesman with over 30 years of experience. “Success or failure?” he asked impishly. I laughed. When I started in stockbroking, anyone older than 50 carried an air of defeat. If they hadn’t made enough money to retire early, they were seen as losers. Well, I’m still here and I’m not the only one. There is a lot more grey hair on the sales desks these days.

That is not the only change. Trading revenue is slimmer, because of regulation and new technology. The way sell-side analysts and salespeople are paid has changed. But the biggest difference is in the kinds of conversation I have and who I have them with. Twenty years ago, I hardly spoke to the fast-money crowd. Now most of my day is taken up with them. Share prices are set at the margin. And the marginal buyer and seller is a hedge-fund manager.

Hedge funds are behind much of the recent market drama. The minutes of the Federal Reserve’s rate-setting meeting last month were a trigger. The immediate prospect of tighter monetary policy spurred hedge funds to sell expensive “growth” shares, notably those of technology companies, the profits of which are expected to last long into the future. Those distant earnings must now be discounted at a higher rate. So tech shares fell. At the same time, a lot of the funds bought cheap “value” stocks.

I specialise in a sector that is seeing selling pressure. But most of my hedge-fund clients trade at a more granular level. They want to bet on the most resilient stocks on my patch and against those that will falter. What matters

to such “long-short” traders is that their longs do better than their shorts. Their investment horizon is days and weeks, not months and years. There are lots of these hedge funds trading lots of stocks. That is why beneath the surface, the stockmarket is so noisy.

Clients want to talk to me. I know my industry well. I have a good team of analysts behind me that is in regular contact with companies. And I talk to a lot of other investors. Everyone has the same hard data—the stock price, the financial statements, the consensus forecasts for earnings and the firm’s “guidance” around those numbers. But the hedge funds are trying to anticipate short-term shifts. They come to me for soft data.

I get asked all sorts of questions. How confident does the finance director of firm X seem about making the numbers? How steely are the investors in the stock—are they committed holders or would they dump it on bad news? Is anyone thinking of buying burnt-out stock Y? Would firm X be open to acquiring firm Y or is it still digesting its latest purchase? No one asks about valuation anymore. When I hear a hedge-fund manager say a stock is cheap or dear, alarm bells ring. He is usually trying to “reverse-broke” me, ie, influence the market by swaying me.

The buy-side used to reward us with fat commissions. Now the biggest brokers allow clients to use their systems to trade directly on the stock exchange at very low cost. Regulators insist that the buy-side pays directly for our advice. These clients agree to pay a fixed sum every year. My performance is measured by “interactions”: the phone calls I make, the meetings I arrange and the requests I respond to. The hedge funds are especially hungry for information. So they pay well.

The buy-side was once a gentler place. Before passive investing put pressure on fees and performance, a dolt could make money in fund management. If you got the dolt drunk regularly, he would allocate you

some commission. I still talk to clients whose investment horizon is five years and not five days. But the conversations are more serious. Boozy lunches have been regulated away. No one has the time for them anyway. The sell-side trader is a marker of cultural change. The old-school version was a red-faced bruiser called Fat Matt or Cardiac Kev. The new model is a triathlete.

Improved health might explain why there are more near-sexagenarians like me around. It's mainly a cohort effect, though. The City grew quickly in the 1990s. Anyone who read "Liar's Poker" figured they'd get rich in sales. But the broking of listed stocks has since lost its mystique. Finance graduates now opt for jobs in private equity—or at hedge funds. My generation has stuck around. Success or failure? I've survived several rounds of cuts. I have a job that I enjoy. I am still pretty well-paid. I think that counts as success, don't you? ■



梧桐

一名资深经纪人认为，金融的新陈代谢加快了

股票由当下行情定价。边际交易者就相当于对冲基金经理

几年前在一次会议上，一个陌生人悄悄走到我身边。因为会上介绍我是一个有着30多年经验的股票销售员，“成功的还是失败的那种？”他打趣问道。我大笑。我刚开始做股票经纪那阵，随便哪个年过五旬的人都散发着一股挫败感。如果没能赚够钱提前退休，别人看你就是输了。嗯，我现在还没退休，而且也不是就我一个人还在。如今在交易台边晃悠的花白脑袋多了许多。

这不是唯一的变化。由于监管和新技术的影响，交易收入越发微薄。卖方分析师和销售人员的薪酬支付方式已经改变。但最大的不同还在于我交谈的对象和内容。20年前，我几乎没有和挣快钱的那伙人说过话。现在我一天的大部分时间都花在他们身上。股票由当下市场行情定价。而边际买家和卖家就相当于一名对冲基金经理。

对冲基金是近期市场上许多戏剧性行情的幕后推手。上月公布的美联储议息会议的会议纪要是个导火索。货币政策收紧的短期前景促使对冲基金卖出昂贵的“成长型”股票，尤其是科技公司的股票，这些公司的利润预计会持续到未来的很长时间。那些遥远的收益现在必须以更高的利率贴现了。科技股因而下跌。与此同时，很多对冲基金买进了便宜的“价值型”股票。

我专注的板块正逐渐面临卖压。但我的大多数对冲基金客户都在更精细的水平上交易。他们希望押注于我的地盘中最有韧性的股票，并做空那些将会下跌的股票。对这种“多空”交易者来说，重要的是他们的多头比空头表现得更好。他们的投资期限是几天和几周，而不是几个月和几年。这样的对冲基金有很多，它们交易的股票也相当多。这就是为什么在表面之下股市是如此嘈杂纷乱。

客户喜欢和我聊。我对自己的行业非常了解。我身后有一支优秀的分析师

团队，他们定期与企业联系。我也和很多其他投资者沟通。每个人都有相同的硬数据——股价、财务报表、对收益的普遍预期以及企业对这些数据的“指引”。但对冲基金正试图预见短期的变化。它们向我寻求软数据。

我被问到各种各样的问题。X公司的财务总监对达成目标数字看起来有多少把握？这只股票的投资者有多坚定——是不离不弃的持有者，还是说一爆出坏消息就会抛掉？有人在考虑买Y这只一蹶不振的股票吗？X公司会对收购Y公司持开放态度，还是仍旧在消化最近的收购？再也没有人问估值了。当我听到一位对冲基金经理说一只股票便宜或贵了时，我脑中就警铃大作。他通常都是在企图“反向代理”我，也就是通过动摇我来影响市场。

买方过去常向我们支付丰厚的佣金。现在，那些最大的经纪商允许客户使用它们的系统以非常低的费用直接在证券交易所交易。监管机构坚持要求买方直接为我们的建议买单。这些客户同意每年支付一个固定的金额。我的业绩用“互动”来衡量：我打的电话、我安排的会议和我回应的请求。那些对冲基金尤其渴望获得信息。所以它们肯花大价钱。

买方这边曾经是个比较温馨的所在。在被动投资给费用和业绩带来压力之前，连傻瓜都可能在基金管理中赚到钱。如果你经常请这个傻瓜喝喝大酒，他还会分你一些佣金。我仍旧会和投资期限为五年而不是五天的客户交流，只不过谈话更严肃了。喝个大醉的午餐已经应监管要求取消了。反正也没人有时间吃吃喝喝。卖方的交易者是文化变革的一个标志。老式交易者的形象是一个红脸大汉，唤作“胖子马特”或“心脏病基夫”。而新式交易员的典范是铁人三项运动员。

健康状况的改善也许可以解释为什么像我这样年近花甲的交易员越来越多。不过主要还是一种同辈效应。伦敦金融城在上世纪90年代发展迅速。任何读过《老千骗局》（Liar's Poker）的人都觉得自己能通过股票交易发财。但之后上市股票经纪业务就失去了神秘感。金融专业的毕业生现在选择在私募股权公司或者对冲基金工作。我们这茬人则一直守在老本行。那我算是成功还是失败呢？我挺过了好几轮裁员。有一份自己喜欢的工作。薪水依然不错。我觉得自己还挺成功的，你不觉得吗？ ■



Omicronic pains

As China's economy slows, policymakers seek to revive growth

Lockdowns and crackdowns are taking their toll

CHINA HAS not enjoyed much success at the sport of curling, which will feature in the Beijing winter Olympics beginning on February 4th. But the country's economic policymakers could draw inspiration from the obscure event. Like curlers, they have a difficult target to hit. They are thought to be aiming for growth of 5% or more in 2022, despite the threat posed by the arrival of the Omicron variant of covid-19, which has appeared in seven provinces, big cities like Shanghai and Tianjin, and was reported in Beijing for the first time on January 15th.

The parallels do not stop there. Just as the curlers must slide a "stone" (a kind of oversized puck) with enough force to reach the target, but not so much that it crashes off the ice, so must China's policymakers strike a balance. They must give a slowing economy enough oomph to grow by 5%, but not so much that it exceeds its limits, contributing to inflation and speculation.

According to figures released on January 17th, China's GDP grew by 8.1% in 2021, its fastest pace since 2011. "Nominal" GDP, which does not adjust for inflation, grew even more quickly: by about 12.6%. And because China's currency also strengthened, its GDP surpassed \$17.7trn (at market exchange rates), an increase of 20% over the year before. Judging by these numbers, the economy would seem to have all the momentum it needs.

But the pandemic so weakened China's economy in early 2020 that the following year was always going to look unusually strong by comparison. As 2021 progressed, growth ebbed (see chart 1). Now the economy must also contend with the Omicron variant. Unlike other countries, China has no

intention to “live with” the virus, even if its latest iteration is less severe than earlier ones. It will instead try to keep covid’s least repressible variant at bay. Mandatory testing in Tianjin, for example, has already forced Toyota to suspend carmaking at its joint venture in the city. Volkswagen has experienced similar problems.

Meanwhile, Delta has not disappeared. A wide-ranging lockdown was imposed on the city of Xi’an in central China after its officials failed to contain an outbreak of the Delta variant quickly enough. Micron, which assembles and tests DRAM microchips (used for temporary storage) in the city, said the measures would have “some impact” on its plant’s output. Samsung also said it will have to “adjust” production at its flash-memory factory, which accounts for about 15% of the world’s capacity for NAND chips, according to TrendForce, a market-intelligence firm. (NAND chips are used for permanent storage.)

China’s overseas customers worry about what would happen if a Xi’an-style lockdown were imposed on a city closer to the heart of the country’s export machine. But optimists point out that China’s export hubs lie mostly in more prosperous regions with more capable governments. They have more effective contact tracing, which could allow their lockdowns to be more precisely targeted. After Omicron infections were discovered in Shanghai, for example, the authorities raised the “risk” level (which entails tightened restrictions on movement) not for the entire city or an entire district, but for zones as small as a bubble tea shop, where three workers were infected. “Zero-covid has maybe 1,000 faces in 1,000 cities”, says one analyst, depending on the resources each place can lavish on the strategy.

The more immediate economic threat posed by Omicron is not to foreign customers but to China’s own consumers. Intermittent restrictions on travel and gatherings have hampered retail spending, which grew by only 1.7% in nominal terms in December, compared with a year earlier, and

shrank, after adjusting for inflation. Goldman Sachs, a bank, thinks further lockdowns this year could cut a full percentage point off growth in household consumption. It has lowered its growth forecast for GDP as a whole from 4.8% to 4.3%, below the government's target.

China's recent economic momentum has also suffered from coal shortages, environmental limits on energy intensity, regulatory crackdowns on consumer-facing tech companies, and strict curbs on borrowing by property developers, which forced several to default, shaking the confidence of homebuyers. In curling, skaters frantically sweep debris and other impediments out of the stone's way to smooth its passage across the ice. In China, policymakers have been doing the opposite, sweeping one regulatory obstacle after another into the economy's path.

What explains this regulatory zeal? After the economy bounced back quickly from the first wave of the pandemic, China's policymakers may have concluded that it was a good time to curb some of the negative side-effects of growth, such as pollution and property speculation. Economic momentum seemed assured. Exports in particular boomed as people around the world spent less on face-to-face services during the pandemic and more on goods to keep them safe (masks), slim (exercise bikes) and sane (games consoles).

But this external source of growth may ebb over 2022. Foreigners are unlikely to splash out again on the home comforts that got them through recent lockdowns. Customers who bought a games console or exercise bike in 2021 probably will not need an upgrade soon. Moreover, for China's exports to grow from their current levels, the splurge would have to be increased, not merely repeated.

Somewhat belatedly, policymakers have now realised that growth needs stabilising. On January 17th China's central bank cut the interest rate on its

one-year loans from 2.95% to 2.85%. That was followed days later by a fall in the reference rates for bank loans. These reductions follow a cut in December in the reserve requirements imposed on banks.

The government is also easing fiscal policy. It has extended income-tax breaks, including favourable treatment for year-end bonuses. It is encouraging local governments to issue more “special” bonds (which are meant to be repaid out of revenues from the infrastructure projects they finance). It is also hastening construction of 102 infrastructure “mega-projects” outlined in the country’s five-year plan for 2021-25. China’s state grid will, for example, build 13 ultra-high-voltage transmission lines in 2022. Increased infrastructure investment could add at least a percentage point to GDP growth in the first half of 2022, according to Morgan Stanley, a bank.

Analysts at Morgan Stanley are relatively confident about the government’s chances of meeting its growth target this year, as long as policymakers bring about a soft landing for the property market. Home sales fell by almost 18% in December, compared with a year before. To arrest this trend, government officials have tried hard to reassure homebuyers that the flats they have bought in advance will be built, even if the developer that sold them goes bust. Mortgage rates are edging downwards. And a number of cities have experimented with subsidies and tax cuts to encourage homebuying. Rosealea Yao of Gavekal Dragonomics, a consultancy, thinks sales will improve in the first quarter compared with the previous three months.

But although China’s national rulers are now committed to stabilising the economy, they are still wary of overstimulating property, which is prone to worrying speculative bubbles. Beijing wants local governments to do enough, but not too much. After the northern province of Heilongjiang promised an “all-out sprint” to revive the property market, the exhortation

was soon removed from the internet, points out Ms Yao. The measured art of curling, not sprinting, is the better metaphor for the government's aims.





奥密克戎之痛

中国经济放缓，政策制定者力求重振增长

封锁措施和行业整顿的影响显现

在将于2月4日开幕的北京冬奥会上，冰壶是一个大项目，不过中国在冰壶赛场上没获得过多大成功。但这项冷门的运动倒是可以给中国的经济政策制定者一些启发。和冰壶运动员一样，他们也面对一个难以触及的目标。据信他们把2022年的经济增长目标定为至少5%，即便面临奥密克戎入侵带来的威胁。目前已有七个省和上海、天津等大城市发现了感染该毒株的病例，1月15日北京也报告了本地首例奥密克戎确诊病例。

两者的相似之处不止于此。正如冰壶运动员必须使出足够的力量让“石壶”（类似大号的冰球）达到目标点，但力量又不能大到让石壶滑出冰面界线，中国的政策制定者也必须取得一种平衡。他们必须对正在放缓的经济施以足够的推力以达到5%的增长目标，但又不能用力过头而推高通胀和助长投机。

根据1月17日发布的数据，中国2021年GDP增长8.1%，是2011年以来的最快增速。不考虑通胀的“名义”GDP增长数字更高：约为12.6%。而且由于人民币走强，按市场汇率计算，中国的GDP超过17.7万亿美元，比上一年增长20%。从这些数字看，中国经济似乎完全具备达到今年的目标所需的势头。

但是，因为中国经济在2020年初受到了疫情的沉重打击，之后一年的经济相形之下自然会显得异常强劲。在整个2021年增长渐趋减弱（见图表1）。现在，中国经济还必须与奥密克戎毒株角力。不同于其他国家，中国无意和新冠病毒“共存”，即使最新的毒株导致的病情较之前的毒株更轻。它将竭力隔绝这一最难遏制的毒株。例如，天津实施的强制检测已迫使丰田在该市的合资工厂暂时停工。大众汽车也遇到了类似的问题。

与此同时，德尔塔毒株也还没有销声匿迹。位处中部的西安市由于未能及

时遏制德尔塔毒株的局部爆发，最终实施了大范围的封锁。在西安组装和测试DRAM芯片（用于暂时存储）的美光（Micron）表示，这些措施将对其工厂的产出造成“一些影响”。三星也表示将不得不“调整”其西安闪存工厂的生产，据市场情报公司集邦咨询的数据，该工厂的NAND芯片（用于永久存储）产能约占全球的15%。

中国的海外客户担心，假如更靠近中国出口制造中心的城市也实施西安式的封锁会如何。但乐观派指出，中国的出口中心大多位于更繁荣的地区，政府的治理能力也更强。那里更高效的流调让封锁更为精准。例如，上海在发现奥密克戎感染病例后，当地政府仅仅调高了一家有三名员工感染的珍珠奶茶店的“风险”等级（会导致收紧出行限制），而不是整座城市或一整个区。“清零政策可能是千城千面”，一位分析师表示，这取决于每个地方能为之投入多少资源。

更直接受到奥密克戎的经济威胁的不是外国客户，而是中国本地的消费者。时不时的出行和聚集限制已经影响到了零售支出，12月的零售总额按名义价值计算仅同比增长1.7%，扣除通胀后甚至为负。高盛认为，今年再实施封锁的话，可能会使居民消费增长减少整整一个百分点。高盛对中国的整体GDP增长预测已从4.8%下调至4.3%，低于中国政府定下的目标。

中国最近的经济发展趋势受到多方面冲击，包括煤炭短缺、对能耗强度的环保限制、面向消费者的科技公司受到监管整顿，以及对房地产开发商贷款的严格限制（多个开发商被迫违约，动摇了购房者的信心）。在冰壶比赛中，刷冰员拼劲刷除石壶前行路径上的碎冰屑和其他障碍物，让它能更顺畅地滑行。在中国，政策制定者近期的做法恰恰相反，他们把一个又一个监管障碍扫到经济前行的道路上。

这种监管热情缘何而起？中国经济在第一波疫情后迅速反弹，政策制定者可能认为这是一个好时机，可以治一治伴随增长而来的一些负面效应，比如污染和房地产投机。经济的好势头似乎板上钉钉。出口尤其红火，因为疫情期间世界各地的人们都减少了在面对面服务上的消费，而花更多钱购买保障自己身心健康的商品，比如口罩、健身车和游戏机。

但这种外部增长源在2022年可能会减弱。外国消费者不太可能一再地大手笔购买帮助他们度过近年封锁期的居家用品。在2021年买了游戏机或健身车的顾客可能不需要很快就升级换代。而且，中国出口要在目前的水平上再有增长，这种大笔消费就必须加码，而非只是重复。

虽然晚了一些，政策制定者现在已经意识到需要稳定增长。1月17日，人民银行将一年期贷款利率从2.95%降至2.85%。几天后，银行贷款基准利率也随之下调。这些都是在12月下调金融机构存款准备金率后做出的降息行动。

政府同时也在放宽财政政策。它延长了所得税优惠期限，包括对年终奖金的计税优惠，还鼓励地方政府发行更多“专项”债券（将依靠所融资兴建的基础设施项目的收入来偿还）。它还在加快2021到2025年十四五规划中的102个基础设施“重大工程”的建设速度。例如，国家电网将在2022年开建13条特高压输电线路。基建投资增加会给2022年上半年GDP增长贡献至少一个百分点，摩根士丹利称。

摩根士丹利的分析师相对来说对中国政府更有信心，认为它能实现今年的增长目标，前提是政策制定者能让房地产市场软着陆。去年12月，中国商品房销售额同比下降近18%。为遏制这股势头，政府官员努力向购房者保证，即使开发商破产，他们预购的房屋也会建成交付。房贷利率也有所下调。一些城市尝试通过补贴和减税的方式鼓励购房。咨询公司龙洲经讯（Gavekal Dragonomics）的咬丽蕾认为，2022年第一季度的房屋销售会好于之前三个月。

但尽管现在中央官员力图稳定经济，他们仍警惕过度刺激房地产——这个行业容易滋生让人忧心的投机泡沫。北京希望地方政府施以足够推力，但不要太多。北方的黑龙江省曾承诺要“全力冲刺”重振房地产市场，但很快就从网上撤下了相关文章，咬丽蕾指出。中国政府的目标不能拿短跑作比，讲究分寸的冰壶才是更好的比喻。■



Free exchange

Will remote work stick after the pandemic?

Speakers at the American Economics Association's annual pow-wow take a shot at the question

BOSTON IS NOT the most popular of winter travel destinations. But many economists were nonetheless disappointed by the news that their profession's grand annual meetings, scheduled to take place in the city in early January, would again be virtual. Greater experience with remote-conferencing technologies meant that events unfolded more smoothly than they did a year ago. That seemed appropriate for a conference dominated by speculation about how covid-19 might permanently alter the economy.

Many sessions were devoted to sketching out the probable features of the post-pandemic world. New habits are sticking—and economists have gathered the data to prove it. Take remote work. Jose Maria Barrero of the Instituto Tecnológico Autónomo de México presented results from research with Nicholas Bloom of Stanford University and Steven Davis of the University of Chicago. Since May 2020 the economists have conducted a monthly survey that, among other things, asks Americans about their plans to work remotely. A year ago, the results suggested that remote work would account for 20% of full-time hours after the pandemic.

Over the past year, however, remote work has gained favour. Based on the survey results from December, the researchers reckon that 28% of hours might ultimately be worked from home. Employees who were once undecided now say they might sometimes work from home, said Mr Barrero. And respondents who had always said they would toil remotely now plan to spend more time doing so. In all, about 15% of full-time workers are expected to be fully remote in future, and just under a third to

work in a “hybrid” fashion—a dramatic change from before the pandemic, when just 5% of people laboured at home.

Remote work will persist because the experience of it has been better than expected, and because workers and firms have invested time and money (together estimated by Mr Barrero to be worth about 0.7% of America’s GDP) in improving it further. But new arrangements will also be driven by employees’ preferences. Though many workers look forward to returning to the office, a sizeable chunk—about 15%—say they would definitely or probably leave employers who do not offer remote options. This has created an opportunity for young firms to attract talent by hiring remotely, said Adam Ozimek of Upwork, a freelance-work platform.

As the opportunities to toil remotely have grown, people have become happier to move away from big, expensive cities. Mr Ozimek noted that research published early in the pandemic suggested that the most significant geographical impact of new working arrangements would be on the distribution of population within cities. Reductions in commuting time as a result of hybrid arrangements would produce a “doughnut effect” as people left city centres for distant suburbs. But analysis of more recent data suggests that moves between cities are increasingly significant. Places with high housing costs and a large share of workers in jobs that can be done remotely have experienced slower growth in house prices and rents than other areas. Whereas data from 2020 sent an ambiguous message about migration trends, figures for 2021 show clear outflows from high-cost places, like California.

Some parts of the world may face uncomfortable adjustments as a result, rather as deindustrialisation placed severe strains on parts of America and Europe in the 1970s and 1980s. Research presented at the conference by Conor Walsh of Columbia University noted that the economic burden of the pandemic fell hardest on less-skilled service workers in dense and

expensive cities, who previously catered to the needs of skilled workers. A permanent exodus of white-collar professionals could leave some less-skilled workers trapped in places with declining job prospects.

A more remote future could yield some offsetting benefits, though. Studies of pockets of the economy suggest that pandemic-related shifts hold the potential for productivity gains. Emma Harrington of Princeton University discussed research showing that the productivity of workers at call-centres rose by 7.6% when work went remote, without a detectable decline in customer satisfaction. Dan Zeltzer of Tel Aviv University presented analysis of the shift to telemedicine in Israel, which showed that the utilisation of resources tended to rise and costs to decline, with little sign of more missed diagnoses or other negative health outcomes.

| *Virtually unrecognisable*

Whether such gains will translate into a stronger macroeconomy is less clear. Janice Eberly of Northwestern University credited remote work with reducing the decline in GDP in early 2020 by nearly half relative to what it might otherwise have been. Yet although remote work might boost companies' profits by lowering the costs of office space, and improve welfare by reducing commuting, she doubted that it was a fundamental enough shift to lead to enduring productivity gains. That chimed with other, more general fears about the post-pandemic economy. Catherine Mann of the Bank of England worried that business investment might prove insufficient, held back by uncertainty about growth prospects and uncompetitive markets. Though investment was strong in 2021, recent surveys show diminished appetite for capital spending, she noted, compared with share buybacks and mergers.

Larry Summers of Harvard University observed that, although central banks may struggle to control inflation in the short term, long-run growth is likely still to be restrained by the same headwinds, such as demographic

change, that blew before covid-19. The upshot of the conference often seemed to be that although economies have done better during the pandemic than many people dared hope, they are likely to disappoint in its aftermath. But as participants from around the globe zoomed seamlessly from session to session, without having to visit an airport or queue up for coffee, one had to wonder whether such conclusions were not a touch too pessimistic. ■



自由交流

疫情过后远程工作将何去何从？

在美国经济学会的年会上，发言者尝试解答这个谜题

波士顿不是最热门的冬季旅游目的地。但当原定1月初在该市举行的经济学界年度盛会再次改为线上举办的消息传来，许多经济学家还是颇感失望。使用远程会议技术方面的经验增长了，此次活动也比一年前开展得更为顺利。这似乎也很应景，毕竟年会的一大主题是疫情可能会如何永久地改变经济。

大会的很多分会场都在勾勒疫情后世界的可能特征。新的习惯正在形成，经济学家有数据为证。以远程工作为例。墨西哥自治理工大学（Instituto Tecnológico Autónomo de México）的何塞·玛丽亚·巴雷罗（Jose Maria Barrero）报告了与斯坦福大学的尼古拉斯·布鲁姆（Nicholas Bloom）和芝加哥大学的史蒂芬·戴维斯（Steven Davis）合作开展的一项研究的发现。三位经济学家从2020年5月开始做月度调查，其中询问了美国人的远程工作计划。一年前，调查结果表明疫情之后远程工作将占全职工作时间的20%。

然而在过去一年里，远程工作越发受青睐。根据12月的调查结果，研究人员估计居家工作的时间最终可能占到28%。巴雷罗说，那些曾经答不上来的员工现在表示他们可能会选择有时在家工作。而一直有远程工作打算的受访者说现在计划增加远程工作时间。总体而言，预计未来约有15%的全职员工将完全远程工作，将近三分之一的人将以“混合”方式工作，这与疫情之前相比变化不小，当时只有5%的人在家工作。

远程工作将会持续下去是因为它的体验比预期要好，而且员工和公司已经为进一步改善它投入了时间和金钱（巴雷罗估计总投入约相当于美国GDP的0.7%）。但员工偏好也会推动新的工作模式。尽管许多员工期待重返办公室，但也有相当一部分人（约15%）表示他们肯定或很可能会离开不提供远程办公选择的雇主。这为年轻公司通过远程雇佣吸引人才创造了机

会，自由职业平台Upwork的亚当·奥济梅克（Adam Ozimek）表示。

随着远程工作机会的增加，人们越来越乐于搬离生活成本高昂的大城市。奥济梅克指出，疫情初期发表的研究认为，新的工作方式在地理方面最显著的影响是城市内的人口分布。混合工作模式所导致的通勤时间减少将产生“甜甜圈效应”：人们搬离市中心，住在偏远的郊区。但对更近期数据的分析表明，城市之间的人口流动越来越显著。与其他地区相比，在住房成本高、有高比例的岗位可以远程作业的地方，房价和租金的涨幅较慢。尽管2020年的数据没有显示出明确的人口流动趋势，但2021年的数据显示加州等高生活成本地区有明显的人口外流趋势。

世界上的某些地区可能会因此而面临痛苦的调整，类似于上世纪七八十年代去工业化对欧美部分地区造成的巨大压力。根据哥伦比亚大学的康纳·沃尔什（Conor Walsh）在年会上介绍的研究，在人口密集、生活成本高企的城市，疫情给技能较低的服务业人员带来了最大的经济压力。疫情前他们的工作是满足技术工人的需求，而白领专业人士的永久性外流可能会把他们中的部分人困在就业前景下滑的地方。

不过，在更久远些的未来可能会出现一些好处，抵消现在的问题。对一些经济领域的研究表明，与疫情相关的转变有可能会提高生产率。普林斯顿大学的爱玛·哈灵顿（Emma Harrington）在发言中谈到的研究表明，改为居家工作之后，呼叫中心工作人员的工作效率提高了7.6%，而客户满意度没有出现可见下降。特拉维夫大学的丹·泽尔特泽（Dan Zeltzer）介绍了对以色列转向远程医疗的分析，呈现出资源利用率上升、成本下降的趋势，几乎没有出现漏诊或其他负面健康结果增加的迹象。

| 虚拟不确定

这些好处是否能转化为更强劲的宏观经济增长就不那么确定了。西北大学（Northwestern University）的珍妮丝·埃伯利（Janice Eberly）认为如果没有远程工作，2020年初的GDP降幅会比实际情况还要多近一半。然而，尽管远程工作可能会通过降低办公空间的成本来提高公司的利润，并通过减少通勤来提升员工幸福感，但她认为这个转变还不足以从根本上带来持

久的生产率提高。这与对疫情后经济其他方面的更普遍担忧相吻合。英国央行的凯瑟琳·曼恩（Catherine Mann）担心，受增长前景不确定和市场缺乏竞争的拖累，企业投资可能出现不足。她指出，尽管2021年投资强劲，但近期的调查显示，与股票回购和合并相比，企业对资本支出的兴趣有所减弱。

哈佛大学的拉里·萨默斯指出，尽管央行在短期内可能还要努力控制通胀，但长期经济增长很可能还是会受到疫情前就已存在的人口结构变化等不利因素的限制。年会的结论很可能会是，尽管经济体在疫情期间的表现好于许多人的想象，但很可能在在疫情后令人失望。不过，看着世界各地的与会者使用Zoom在各个分会场之间无缝切换，而不必去机场或排队等咖啡，你禁不住要怀疑这样的结论是否有点过于悲观了。■



When you are in a hole...

How Africa can reduce its reliance on commodities

Invest the profits in infrastructure and people

IN EASTERN SIERRA LEONE six shoeless men thwack shovels into a bank of reddish earth and heave the dirt into a stagnant pond. They hope to find diamonds. Even if they do, they will not strike it rich. The men are paid about \$0.90 a day by a backer who bought the licence to mine and who keeps 70% of anything they find. The remainder adds up, on average, to about \$135 a year each, says one. Ibrahim, a 25-year-old wearing a sodden sock to protect his foot from the metal shovel, is a third-generation miner. He does not earn enough to send his children to school. "If I cannot support my children to be educated, how can I be sure they will not come here, too?" he asks.

Like Ibrahim's family, many African economies have relied too much on raw materials for too long. The UN defines a country as dependent on commodities if they are more than three-fifths of its physical exports. Fully 83% of African countries meet that threshold, up from 77% a decade ago. Some depend on produce such as tea, but most rely on mining or on pumping oil. When commodities crashed in 2015, foreign direct investment (FDI) and growth tumbled and have yet to fully recover.

Broad averages obscure some of the progress that has been made to diversify economies. Over the past decade resources have become less important to GDP. The share of commodities in goods exports from the continent as a whole has fallen, too. And in countries such as Botswana and Malawi, services have grown strongly. Even manufacturing is rebounding.

Yet Africa has a long way to go if it is to break free of the resource curse. In countries rich in diamonds or oil, political power can be a licence to loot.

So unscrupulous folk are tempted to grab and hang on to it by any means available. Resource-rich countries are more likely to suffer dictatorships, and also tend to have more and longer civil wars. In Sierra Leone, for example, diamonds fuelled a bloody conflict that dragged on for 11 years.

Commodity prices leap and fall, leading to booms and busts. In Sierra Leone the normally sober IMF, excited by two new iron-ore mines and high prices, forecast growth of 51% for 2012. That spurred the government to splash out. But GDP that year grew by 15%. In 2014 iron-ore prices plunged and the mines closed. The economy, which was also hit by Ebola, shrank by 20% in 2015. “When the mine stops, it’s bad for business,” says Idrissa, who sells bags in Lunsar, a mining town.

Oil and minerals create few jobs. At a gold mine in Sierra Leone the Chinese manager’s six ducks watch as a solitary red lorry dumps rubble. The avian observers outnumber the workers on duty. Across this country of 8m people, about 8,000 work in commercial mines. Cash crops create more jobs, but, without processing, do relatively little to improve productivity (which is needed to make a country rich).

Worse still, commodities exports can often hold back the rest of the economy by pushing the exchange rate up and making other exports uncompetitive. Every extra dollar in foreign currency earned from exporting resources reduces non-resource exports by \$0.74, reckon Torfinn Harding of the NHH Norwegian School of Economics and Anthony Venables of Oxford University. So tight is this straitjacket that Michael Ross of the University of California found that among 38 big oil exporters, neither good government nor democracy has any solid relation with diversification. The only thing that correlates is having less oil.

Yet it is too easy to blame economics alone. “The fault, dear Brutus, is not in our stars but in ourselves,” quips Herbert M’cleod, who is based in Sierra

Leone for the International Growth Centre, a research outfit. Governments often spend windfalls from commodities on fat salaries rather than investing them in infrastructure or education. They are “eating the future”, laments Paul Collier of Oxford University. All too often when cash is tight, politicians try to renegotiate existing deals to get more tax, or simply grab mining or oil companies. “Let’s own the minerals ourselves,” muses Jacob Jusu Saffa, the chief minister (ie, prime minister) of Sierra Leone, in frustration at the lack of revenue. “Let’s own the companies.” Yet the result of state ownership is usually idle or unprofitable mines and angry investors who take their money and skills elsewhere.

Often overlooked is the reality that some politicians simply do not want to diversify. Money from oil tends to go through state coffers, where greedy hands can skim it off. Politically connected bigwigs often benefit in other ways too, says Rabah Arezki, a former chief economist at the African Development Bank. In many cases imports, which tend to jump during commodity booms, are controlled by a few big players. If there is little competition from domestic producers, they can bump up prices and gouge ordinary folk. As long as they share some of this wealth with their friends in politics, the government will do little to encourage local production. In any case, creating, say, a clothing industry from scratch is slow, so there is little reason for politicians to put in the effort if the credit will be claimed by their successors.

Even so, it is possible for governments to manage their commodities better. One basic principle, especially for things like oil and minerals that will run out, is to turn riches in the ground into other sources of wealth, such as roads or an educated population. The World Bank now argues that, even if countries cannot diversify their exports, they will still be making progress if they diversify their sources of wealth.

Sierra Leone’s government is taking note. It now spends about 21% of its

budget on education, up from 13% in 2017. As a result, more youngsters are passing their final exams than ever before. Mining began in Sierra Leone about a century ago. “If we had invested in humans for a hundred years,” sighs David Moinina Sengh, the education minister, “we would be in a much better place today.” ■



当你掉进坑里.....

非洲如何能减少对大宗商品的依赖

把收益投资到基础设施和人身上

在塞拉利昂东部某地，六个光脚的男人用力把铁锹插入红土坡中，再挥锹把泥土铲进一个死水塘里。他们希望找到钻石。不过就算找到了，他们也发不了大财。他们从买下了采矿权的投资人那里领取每天0.9美元的报酬，这个投资人拿走任何收获物的70%。其余的每个人能分到平均每年大概135美元，其中一个男人说。25岁的易卜拉欣（Ibrahim）一家三代都是矿工，他穿着湿透的袜子以防被铁锹伤到脚。他挣的钱不够送自己的孩子们上学。“如果供不起孩子读书，我怎么能确保他们以后不来这里？”他问道。

像易卜拉欣的家庭一样，许多非洲经济体过度依赖原材料已经太久。按照联合国的定义，如果一个国家的大宗商品占到本国实物商品出口额的五分之三以上，就是大宗商品依赖国。如今足足83%的非洲国家达到了这一阈值，而十年前这一比例为77%。有些国家依赖茶叶等农产品，但大多数依赖矿产或石油开采。2015年大宗商品价格暴跌后，外国直接投资和经济增长骤降，至今仍然没有完全恢复。

泛泛而论的平均数字掩盖了在经济多样化方面取得的一些进展。在过去十年里，资源对GDP的重要性已经有所下降。大宗商品在整个非洲出口商品中所占的比例也降低了。在博茨瓦纳和马拉维等国家，服务业增长强劲。甚至连制造业也在回升。

然而要摆脱资源魔咒，非洲还有很长的路要走。在钻石或石油储量丰富的国家，政治权力可以为掠夺大开方便之门。所以一些无耻之徒往往要不择手段地攫取并抓牢政治权力。资源丰富的国家更有可能遭受独裁统治，内战也往往更频繁持久。例如塞拉利昂就爆发过一场由钻石引发的流血冲突，持续11年之久。

大宗商品价格忽上忽下，导致经济也在繁荣与萧条间起起落落。一向淡定的国际货币基金组织（IMF）曾因为塞拉利昂新发现两处铁矿加之铁矿石价格走高，兴奋地预测该国经济在2012年将增长51%。受此鼓舞的塞拉利昂政府开始大肆挥霍。但那一年GDP实际只增长了15%。2014年，铁矿石价格暴跌，两座矿山关闭。加上受到埃博拉病毒的打击，塞拉利昂经济在2015年萎缩了20%。“矿停了，生意就难做了。”在矿业城镇隆萨（Lunsar）卖包装袋的伊德里萨（Idrissa）说。

石油和矿物开采创造不出多少就业岗位。在塞拉利昂的一座金矿，仅有的一辆红色卡车正在倾倒碎石，中国经理养的六只鸭子在一旁观望。上班的工人还没有鸭子多。在这个800万人口的国家，大约有8000人在商业化矿山工作。经济作物创造的岗位更多些，但因为不涉及加工，对提高生产率（这是让国家富裕的必由之路）的作用也就相对较小。

更糟糕的是，大宗商品出口往往会推高汇率，使其他出口商品丧失竞争力，从而阻碍其他经济领域的发展。挪威经济学院（NHH Norwegian School of Economics）的托芬·哈丁（Torfinn Harding）和牛津大学的安东尼·维纳布尔斯（Anthony Venables）认为，出口资源类商品每赚到一美元外汇，出口非资源类商品就会少赚0.74美元外汇。资源类商品的束缚是如此深重，加州大学的迈克尔·罗斯（Michael Ross）发现，在38个石油出口大国中，无论是治理良好的政府还是民主制度都与经济多样化没有任何确切关联。唯一与之相关的是石油储量的减少。

然而人们太容易把问题全部甩锅给经济规律。“亲爱的布鲁特斯，错并不在命运，而在我们自己。”研究机构国际增长中心（International Growth Centre）在塞拉利昂的工作人员赫伯特·麦克劳德（Herbert M'cleod）引用莎士比亚戏剧《凯撒大帝》里的一句话打趣道。非洲各国政府经常把大宗商品带来的横财花在领取高薪上，而不是投资于基础设施或教育。他们正在“透支未来”，牛津大学的保罗·科利尔（Paul Collier）哀叹道。当资金紧张时，政客们往往试图重新谈判现有协议，以收取更多税款，或者干脆霸占矿产或石油公司。“让我们把矿产收归己有，”对财政匮乏感到懊恼的塞拉利昂首席部长（即总理）雅各布·朱苏·萨法（Jacob Jusu Saffa）

若有所思地说，“让这些公司都归我们。”然而，国有制常常导致矿山闲置或者无利可图，愤怒的投资者把资金和技术转投别处。

一个经常被忽略的事实是，一些政客根本不想让经济多样化。石油换来的钱财往往会经过国库，贪官们可以从中大捞一笔。政治关系四通八达的权贵们还经常通过其他方式捞油水，非洲开发银行（African Development Bank）的前首席经济学家拉巴赫·阿尔扎基（Rabah Arezki）表示。在大宗商品市场的繁荣期，进口往往会大幅增加，而在很多情况下，进口掌握在少数几个大玩家手里。如果鲜有来自国内生产商的竞争，他们就可以抬高价格，盘剥百姓。只要他们把这些不义之财分一部分给自己的政客朋友，政府基本上就不会鼓励本地生产。再说，从零开始创建一个产业（比如说制衣业）是个漫长的过程，如果这些功劳要被记到自己的继任者头上，政客们也就没什么理由要为此努力。

即便如此，非洲各国政府还是有可能更好地管理自己的大宗商品资源。一个基本理念是把地下的财富，尤其是石油、矿产等终将枯竭的资源，转化为其他的财富来源，比如道路或受过教育的人口等。世界银行如今认为，即使各国无法实现出口商品的多样化，但如果它们能做到财富来源多样化，仍然会取得进展。

塞拉利昂政府已经开始意识到了这一点。教育占该国预算的比例从2017年的13%上升到了现在的21%。随之而来的变化是现在通过期末考试的年轻人比以往任何时候都要多。塞拉利昂的采矿业起始于大约一个世纪前。“如果一百年前我们就开始在国民身上投资，”教育部长大卫·莫尼纳·森格（David Moinina Sengeh）叹息道，“我们如今的境况会好很多。”■



Bartleby

Remote work and the importance of writing

The written word will flourish in the post-pandemic workplace

THE PANDEMIC has given a big shove to all forms of digital communication. Video-conferencing platforms have become verbs. Venture capitalists make their bets after watching virtual pitches. Products like Loom and mmhmm help workers send pre-recorded video messages to their colleagues. More than a third of Slack users each week are now “huddling”—using the product’s new audio feature to talk to each other. And all this is before the metaverse turns everyone into an avatar.

A workplace dominated by time on screens may seem bound to favour newer, faster and more visual ways of transmitting information. But an old form of communication—writing—is also flourishing. And not just dashed-off emails and entries on virtual whiteboards, but slow, time-intensive writing. The strengths of the written word have not been diminished by the pandemic era. In some ways they are ideally suited to it.*

The value of writing is a staple in management thinking. “The discipline of writing something down is the first step toward making it happen,” reckoned Lee Iacocca, a quotable titan of the American car industry. Jeff Bezos banned slide decks from meetings of senior Amazon executives back in 2004, in favour of well-structured memos. “PowerPoint-style presentations somehow give permission to gloss over ideas,” he wrote.

Some executives write for themselves. Andrew Bosworth, a bigwig at Meta (formerly Facebook), has a blog in which he muses interestingly on many topics, including on writing itself: “In my experience, discussion expands the space of possibilities while writing reduces it to its most essential components.” Others do so to reach an audience. Shareholder letters from

Larry Fink and Warren Buffett are the corporate equivalent of a blockbuster book launch.

But the move to remote working has enhanced the value of writing to the entire organisation, not just the corner office. When tasks are being handed off to colleagues in other locations, or people are working on a project “asynchronously”, meaning at a time of their choosing, comprehensive documentation is crucial. When new employees start work on something, they want the back story. When veterans depart an organisation, they should leave knowledge behind. Writing everything down sounds like an almighty pain. But so is turning up to a meeting and not having the foggiest what was decided last time out.

Software developers have already worked out the value of the written word. A research programme from Google into the ingredients of successful technology projects found that teams with high-quality documentation deliver software faster and more reliably. Gitlab, a code-hosting platform whose workforce is wholly remote, frames the secret of successful asynchronous working thus: “How would I deliver this message, present this work, or move this project forward right now if no one else on my team (or in my company) were awake?” Gitlab’s answer is “textual communication”. Its gospel is a handbook that is publicly available, stretches to more than 3,000 pages and lays out all of its internal processes.

The deliberation and discipline required by writing is helpful in other contexts, too. “Brainwriting” is a brainstorming technique, used by Slack among others, in which participants are given time to put down their ideas before discussion begins. Lists of corporate values can make greeting cards seem hard-hitting. But thoughtful codification of a firm’s culture makes more sense in hybrid and remote workplaces, where new joiners have less chance to meet and observe colleagues.

Purists will sniff that none of this counts as writing. But good prose and useful prose share the same essential qualities: brevity, structure, a clear theme. Cormac McCarthy, a prize-winning novelist, copy-edits scientific papers for fun. Ted Chiang says that his science-fiction short stories and his technical writing both draw on a desire to explain an idea clearly.

Writing is not always the best way to communicate in the workplace. Video is more memorable; a phone call is quicker; even PowerPoint has its place. But for the structured thought it demands, and the ease with which it can be shared and edited, the written word is made for remote work.

*Cynical readers may question a paean to the written word in a publication that sells a fine style guide and runs courses on business writing. They are welcome to write in. ■



巴托比

远程工作与生花妙笔

书面写作将在疫情后的职场中大放光彩

疫情极大地推动了各式各样的数字通讯。视频会议软件的名字已被当成动词来用。风险投资人在线上观看项目推介，然后做出投资决定。Loom和mmhmm这类产品帮助员工向同事发送预先录制好的视频消息。现在每周都有超过三分之一的Slack用户使用新语音功能“huddle”互相交谈。所有这些都还发生在元宇宙让每个人都拥有虚拟化身之前。

随着显示屏在职场大行其道，更新、更快、更直观的信息传递方式看来注定会更受青睐。但一种古老的沟通形式也越发盛行——书面写作。而且并不仅仅是匆匆写下的电子邮件和虚拟白板上的条目，而是那种缓慢而耗时的写作。书面写作的优势并未因进入疫情时代而削减。在某些方面，它非常契合这个时代。*

写作的价值是管理理论中的常见议题。“你得把东西写下来，那是实现它的第一步。”屡出妙语的美国汽车行业知名人物李·艾柯卡（Lee Iacocca）说。早在2004年，贝索斯就禁止亚马逊高管在会议上使用幻灯片，而是使用条理清晰的备忘录。“用PPT做演示不知怎地能让人掩饰自己的想法。”他写道。

一些高管给自己写。Meta（Facebook的前身）的大腕安德鲁·博斯沃思（Andrew Bosworth）有一个博客，兴味盎然地思考许多话题，其中就包括写作本身：“以我的经验来说，讨论扩展了可能性的空间，而书写提炼出其中最关键的要素。”其他高管写给很多人。拉里·芬克（Larry Fink）和巴菲特每年的致股东信都堪称企业界的一次畅销书发布。

但是，向远程办公的转变提升了写作对整个组织的价值，而不仅仅是对高管。在向其他地点的同事移交工作时，或者员工们在一个项目上“异步”工作（也就是自由选择工作时间）时，全面的文档记录至关重要。当新员工

开始接手一件任务，他们需要了解来龙去脉。当资深员工离职时，他们应该把自己的知识留下来。将一切都付诸纸笔听起来麻烦至极。但当你出席一次会议，却对上次会议的决议一无所知，又何尝不要抓耳挠腮。

软件开发者已经意识到书面文字的价值。谷歌的一项研究探究了技术项目的成功要素，发现拥有高质量文档记录的团队往往能更快、更可靠地交付软件。代码托管平台Gitlab的员工全部远程工作，它将异步工作的成功秘诀归纳为一个问题：“如果现在我团队（或公司）的其他人都睡着，我该如何传递这条消息、展示这项工作，或者推进这个项目？”Gitlab的答案是“文本沟通”。它的“福音书”是一本3000多页的公开手册，里面列出了所有的内部流程。

写作所需的深思熟虑和规范严谨在其他场景中也有用处。

“Brainwriting”（书面头脑风暴法）是Slack等公司都在使用的一种头脑风暴方法。开始集体讨论之前，先让参与者把自己的想法写下来。在贺卡中罗列企业价值观也许会少些人情味。但把公司文化精心总结成文在混合和远程办公的职场更有用处，因为在这种环境中新入职的员工较少有机会见到和观察同事。

纯粹主义者会嗤之以鼻，认为这些都算不上写作。但是优美文章和实用文章都有相同的基本特质：文笔简洁、结构清晰、主题明确。获奖小说家科马克·麦卡锡（Cormac McCarthy）以编审科学论文为乐。姜峯楠（Ted Chiang）说，他的科幻短篇小说和科技写作都源自同一种愿望，就是把一个想法解释清楚。

写作并不总是职场沟通的最佳方式。视频让人印象更深；打电话速度更快；就连PPT也有自己的用武之地。但就书写所需的结构化思考以及分享和编辑的便利性而言，它可谓远程工作的绝配。

*有些喜好怀疑的读者可能会质疑我们对书面文字如此大唱赞歌，毕竟本刊对外发售一本质量不错的写作风格指南，还开设了商务写作课程。我们欢迎来信指正。 ■



Seismology

Predicting earthquakes is not possible. Yet

But an intriguing new approach shows promise

ONE OF THE questions most frequently asked of the United States Geological Survey is whether earthquakes can be predicted. Their answer is an unconditional “no”. The relevant page on the agency’s website states that no scientist has ever predicted a big quake, nor do they know how such a prediction might be made.

But that may soon cease to be true. Though, after decades of failed attempts and unsubstantiated claims about earthquake prediction, a certain scepticism is warranted—and Paul Johnson, a geophysicist at Los Alamos National Laboratory, is indeed playing down the predictive potential of what he is up to—it is nevertheless the case that, as part of investigations intended to understand the science of earthquakes better, he and his team have developed a tool which might make forecasting earthquakes possible.

As do so many scientific investigations these days, their approach relies on artificial intelligence in the form of machine learning. This, in turn, uses computer programs called neural networks that are based on a simplified model of the way in which nervous systems are thought to learn things. Machine learning has boomed in recent years, scoring successes in fields ranging from turning speech into text to detecting cancer from computerised-tomography scans. Now, it is being applied to seismology.

| *Slip-sliding away*

The difficulty of doing this is that neural networks need vast amounts of training data to teach them what to look for—and this is something that earthquakes do not provide. With rare exceptions, big earthquakes are caused by the movement of geological faults at or near the boundaries

between Earth's tectonic plates. That tells you where to look for your data. But the earthquake cycle on most faults involves a process called stick-slip, which takes decades. First, there is little movement on a fault as strain builds up, and there are therefore few data points to feed into a machine-learning program. Then there is a sudden, catastrophic slippage to release the accumulated strain. That certainly creates plenty of data, but nothing particularly useful for the purposes of prediction.

Dr Johnson thus reckons you need about ten cycles' worth of earthquake data to train a system. And, seismology being a young science, that is nowhere near possible. The San Andreas fault in California (pictured), for example, generates a big earthquake every 40 years or so. But only about 20 years (in other words, half a cycle) of data sufficiently detailed to be useful are available at the moment.

In 2017, however, Dr Johnson's team applied machine learning to a different type of seismic activity. Slow-slip events, sometimes called silent earthquakes, are also caused by the movement of plates. The difference is that, while an earthquake is usually over in a matter of seconds, a slow-slip event can take hours, days or even months. From a machine-learning point of view this is much better, for such an elongated process generates plenty of data points on which to train the neural network.

Dr Johnson's classroom is the Cascadia subduction zone, a tectonic feature that stretches 1,000km along the coast of North America, from Vancouver Island in Canada to northern California. It is the boundary between the Explorer, Juan de Fuca and Gorda plates to the west, and the North American plate to the east. Steady movement of the latter plate over the former three generates a slow-slip event every 14 months or so, and geophysicists have recorded this activity in detail since the 1990s. That means there are plenty of complete cycles of data—and the machine-learning system trained on these by Dr Johnson was able to “hindcast” past

slow slips based on the seismic signals which preceded them, “predicting” when they would happen to within a week or so of when they had occurred in reality.

The next test of the technique, yet to be executed, will be an actual forecast of a slow-slip event. But even without this having happened, Dr Johnson’s slow-slip project suggests that machine-learning techniques do indeed work with seismic events, and might thus be extended to include earthquakes if only there were a way to compensate for the lack of data. To provide such compensation, he and his colleagues are applying a process called transfer learning. This operates with a mixture of simulated and real-world information.

| *Getting real*

“Lab quakes” are miniature earthquakes generated on a laboratory bench by squeezing glass beads slowly in a press, until something suddenly gives. This has proved a useful surrogate for stick-slip movement. Dr Johnson’s team have created a numerical simulation (a computer model that captures the essential elements of a physical system) of a lab quake and trained their machine-learning system on it, to see if it can learn to predict the course of the surrogate quakes.

The result is moderately successful. But what really makes a difference is boosting the trained system with extra data from actual experiments—in other words, transfer learning. The combination of simulated data fine-tuned with a pinch of the real thing is markedly more effective at predicting when a lab quake will occur.

The next step towards earthquake forecasting will be to apply the same approach to a real geological fault, in this case probably the San Andreas. A machine-learning system will be trained on data from a numerical simulation of the fault, plus the half-cycle’s worth of live data available. Dr

Johnson's team will see if this is enough to hindcast events not included in the training data. He mentions the magnitude-six Parkfield earthquake in 2004—a slippage of the San Andreas that did minimal damage, but was extremely well studied—as one possible target.

At present Dr Johnson's aspirations are limited to predicting the timing of an imminent quake. A full prediction would also need to include whereabouts along the fault it was going to happen and its magnitude. However, if timing can indeed be predicted, that will surely stimulate efforts to forecast these other criteria, as well.

He hopes for initial results in the next three to six months, but cautions that it might take longer than that. If those results are indeed promising, though, there will no doubt be a rush of other teams around the world attempting to do likewise, using historical data from other earthquake-producing faults in order to validate the technique. That, in turn, should improve the underlying model.

If it all comes to naught, nothing will have been lost, for Dr Johnson's work will certainly provide a better understanding of the physics of big earthquakes, and that is valuable in and of itself. But, if it does not come to naught, and instead creates software capable of predicting when big quakes will happen, that really would be an earth-shaking discovery. ■



地震学

地震还不可预测。暂时如此

但一种新奇的方法显现了希望

美国地质勘探局（United States Geological Survey）最常被问的问题之一是地震是否可以预测。他们的回答是斩钉截铁的“不能”。根据该机构官网上相关网页的说法，还没有哪位科学家成功预测过一场大地震，而且他们也不知道如何能做出这样的预测。

但事情可能很快会有变化。虽说鉴于几十年来地震预测屡试屡败，加上成功预测了地震的说法也未曾证实，一定的怀疑合情合理——实际上，美国洛斯·阿拉莫斯国家实验室（Los Alamos National Laboratory）的地球物理学家保罗·约翰逊（Paul Johnson）对于自己的研究在地震预测方面的潜力确实很低调。但也无可否认，在为了更好地认识地震科学的各种研究中，约翰逊和他的团队开发的一种工具或许会让地震预测成为可能。

就和当今许多科学研究一样，他们的方法也依赖人工智能，具体来说就是机器学习。而机器学习又要运用被称为神经网络的计算机程序——一种根据对神经系统学习功能的认识而做出的简化模型。机器学习近年来蓬勃发展，并在很多领域有所建树，比如将语音转录为文本、通过计算机断层扫描检测癌症等。现在，它又被应用到了地震学中。

| 悄然滑走

在地震学中应用机器学习的困难是，要教会神经网络寻找目标就需要给它们提供海量的训练数据，而这是地震无法提供的。除了极少数的例外，大地震都是由位于或靠近地球构造板块边界的地质断层运动引起。这就告诉了人们该去哪里找数据。但大多数断层上的地震周期都有一个叫作粘滑运动的过程，这个过程需要几十年的时间。开始时，应变在积累，断层上几乎没有活动，也就几乎没有可以输入机器学习程序的数据点。之后会突发灾难性的滑移，以释放累积的应变。这无疑会产生大量的数据，但对于预测的目的来说却都没有太大的用处。

因此约翰逊认为，要训练系统需要大约十个地震周期的数据。而地震学是门年轻的科学，根本不可能做到这一点。例如，加州的圣安地列斯（San Andreas）断层（如图）每40年左右就会发生一次大地震。但目前只有大约20年（也就是半个周期）的足够详细的可用数据。

不过，约翰逊的团队从2017年开始将机器学习应用于另一种类型的地震活动。这就是慢滑事件，有时被称为无声地震，也是由板块运动引起的。不同之处在于，一次地震只有短短几秒钟，而慢滑事件可能持续几小时、几天甚至几个月。从机器学习的角度来看这要有利得多，因为这样一个拉长的过程会产生大量可供训练神经网络的数据点。

约翰逊的考察目标是卡斯卡迪亚（Cascadia）俯冲带，这个地壳构造沿北美海岸绵延1000公里，从加拿大的温哥华岛一直延伸到加州北部。该俯冲带是西边的探险家（Explorer）、胡安·德富卡（Juan de Fuca）、戈尔达（Gorda）三个板块与东边的北美板块的交界带。北美板块持续在前三个板块的上方运动，大约每14个月就会引发一次慢滑事件，地球物理学家从上世纪90年代就开始详细记录这一活动。这意味着已有大量的完整周期数据。约翰逊用这些数据训练机器学习系统，能够根据以往慢滑运动发生前的地震信号“预测”出这些慢滑事件，与实际发生时间的误差不超过前后一周。

对这项技术的下一步检验尚未开展，那就是真正预测未来的慢滑事件。但即使还没有这一步，约翰逊的慢滑研究项目也表明机器学习技术确实适用于地震事件，因此只要找到方法来弥补数据上的不足，这项技术就可能被扩展到地震。为了弥补这种不足，他和同事正在运用一种名为迁移学习的方法，它使用模拟与真实世界的混合信息。

| 回归现实

“实验室地震”是在实验室工作台上制造的微型地震，方法是用挤压设备慢慢挤压玻璃珠，直到有玻璃珠突然变形。事实证明它能很好地模拟粘滑运动。约翰逊的团队已经建立了一个实验室地震的数值模拟（一种采集了一个物理系统基本要素的计算机模型），并以此训练自己的机器学习系统，

看它能否学会预测这些模拟地震的进展过程。

结果还算成功。但真正带来不同的是用实际实验产生的额外数据提升受训练的系统——换句话说，就是迁移学习。经过微调的模拟数据与少量的真实数据相结合，能明显提升对实验室地震发生时间的预测。

通往地震预测的下一步将是把同样的方法应用于真实的地质断层，在约翰逊的研究中很可能就是圣安地列斯断层。机器学习系统将接受两组数据的训练，一组是该断层的数值模拟，另一组是已有的半个地震周期的实际数据。约翰逊的团队要看看这是否足以“预测”出不在训练数据中的地震事件。他提到2004年发生在美国帕克菲尔德（Parkfield）的六级地震可能会是一个计算对象。这场地震由圣安地列斯断层的滑移造成，破坏很小，但已被非常深入细致地研究。

目前，约翰逊的抱负还只限于预测即将发生的地震的确切时间。一项全面的预测还应包括地震会发生在断层带的什么位置，以及震级等。然而，如果发生时间确实可被预测，那肯定也会激发人们努力去预测这些其他指标。

他希望在接下来的三到六个月内能有初步结果，但也提醒说可能需要更长时间。不过，如果结果确实显现出前景，那么毫无疑问，世界各地的其他团队也会争相尝试同样的方法，使用来自其他地震断层的历史数据来验证这项技术。而这应该会进一步完善基础模型。

就算这一切化为泡影，也不会有任何损失，因为约翰逊的工作肯定能让人们更好地理解大地震的物理特性，这本身就很有价值。但如果没落空，而是开发出了能够预测大地震何时发生的软件，那真将是个震天动地的发现。■



The new great game

Can big oil's bounce-back last?

Why American oil companies are different

CALLS FOR the oil business to decarbonise are growing louder just about everywhere, and not merely from governments and environmentalists. Moody's, a rating agency, reckons that half of the \$1.8trn of global energy debt that it evaluates is held by asset managers and insurers that face increasing pressure on environmental, social and governance (ESG) fronts, notably the climate. An annual survey of 250 big institutional investors published on January 6th by the Boston Consulting Group (BCG) found that more than four in five think it is important for companies to establish targets for long-term emissions reductions. Nearly as many "feel increased pressure" to apply green filters to their investments.

At the same time, the International Energy Agency, a global forecaster, expects worldwide oil consumption to return to its pre-pandemic level of 100m barrels a day (b/d) in 2022. Even if it rose by no more than 1% per year after that, the natural rate of reservoir depletion means that 12m-17m b/d of new supply must be added in the next five years to meet demand, reckons Alastair Syme of Citigroup, a bank. Investors recognise this. As economies reopened last year after the worst ravages of the pandemic and the oil price recovered—this month it is flirting with a seven-year high of \$85 a barrel—energy became the best performing sector in the S&P 500 index of large American firms, ahead of technology and finance. It left environmentally friendly stock picks in the dust (see chart).

This tension was on display last month at the World Petroleum Congress in Houston, a triennial celebration of hydrocarbons attended by more than 1,000 energy ministers, oil bosses and other industry luminaries. Houston's mayor, Sylvester Turner, kicked off the proceedings by declaring

that “as the energy capital of the world, we have a moral obligation to reduce carbon emissions.” Shortly afterwards Amin Nasser, chief executive of Saudi Aramco, the world’s oil colossus, warned of inflation and social chaos unless countries accept that “oil and gas will play an essential role during the transition.” Between visits to booths where oil companies from Aramco to ExxonMobil, an American super major, competed to appear lower-carbon than rivals, attendees could be seen wringing their hands about falling capital spending on exploration and production, which declined from around \$500bn globally in 2019 to \$350bn in 2020. Daniel Yergin, a Pulitzer-prizewinning energy wiseman at IHS Markit, a consultancy, warned that “pre-emptive underinvestment” risks hurting the world economy.

| *Not in concert*

Listen closely, though, and the cacophony reveals the mix of strategies that big oil is pursuing as it looks ahead to the next decade and beyond. The Europeans are increasingly going all in on greenery. The state-controlled giants such as Aramco are biding their time. And the Americans are engaged in a delicate balancing act somewhere in between.

The European firms’ approach represents the sharpest break with the past. They are divesting many oil assets, especially the dirtiest ones, and replacing them with bets on green-power generation. In December Shell, a British giant, completed a \$9.5bn sale of shale fields in America’s rich Permian basin. BP, another British major, and Total Energies, a French one, have sold off, respectively, some \$3bn and \$2.3bn in assets since October 2020.

Bernard Looney, BP’s boss, has defended his firm’s shift by insisting that “this isn’t charity, this isn’t altruism.” Perhaps. But nor is it as good a business as pumping oil. IHS Markit estimates that global investments in oil and gas have generated a median annual operating return on capital of

8.3% since 2010, compared with 5% for renewables. Moreover, green energy is unfamiliar territory for the oil companies, where they face stiff competition from incumbents such as Orsted and Vestas, two European renewables giants. One analyst calls it the “low return, low regret” strategy.

By contrast, the national oil giants’ approach could be summed up as “high returns, no regrets”. The Persian Gulf behemoths, led by Aramco, have the biggest conventional oil reserves and lowest costs. In an ironic twist of geology, Saudi Arabia’s reserves are also among the least carbon-intensive to develop. Largely impervious to pressure from shareholders and environmentalists, their share of global oil investments has risen from around a third in the early 2000s to more than half. According to Bob Brackett of Bernstein, an investment firm, the dilemma for the state-controlled behemoths is how to keep oil prices high without choking off demand.

American oil companies cannot afford to be as patient as the Gulf petro-states. They also reject the European retreat from crude. Their strategy does involve a degree of decarbonisation. But its centrepiece is trying to become ever more efficient at pumping oil while resisting the urge to splurge on new capacity whenever oil prices go up.

The American firms’ decarbonisation drive is different from the European one in two ways. They are funnelling far less of their future capital spending to low-carbon projects compared with counterparts across the Atlantic. And the lion’s share is not going on ventures that replace hydrocarbons but on limiting or offsetting the companies’ climate impact.

Most of America’s big oil companies have plans to limit leaks of methane, a powerful greenhouse gas, from their pipelines and to produce hydrogen, a promising clean fuel, from natural gas. Exxon Mobil is spearheading a proposed \$100bn carbon-capture-and-storage consortium. Analysts

observe that the shallow-water leases in the Gulf of Mexico that the firm recently acquired do not fit with its oil strategy but are suited to storing carbon dioxide. More ambitiously still, Occidental Petroleum is helping scale up the world's largest "direct air capture" facility to suck carbon dioxide from the air, whose construction will begin this year in the Permian. "There is no more arguing...climate change is real and we have to address it," insists Vicki Hollub, Occidental's boss.

In time, such projects may play a role in cleaning up the climatic mess that the oil industry has had a hand in creating. For now they remain a sideshow and, in the candid words of one American oil boss, "provide cover" for investors who need to genuflect to ESG activists. Indeed, both the shareholders and managers of America's oil companies have a clear primary objective—to milk the high oil prices without succumbing to capital indiscipline that has often followed spells of pricey crude.

Nowhere is this clearer than among the country's shale producers. S&P Global Platts, a research firm, points to big improvements in productivity and efficiency in America's shale patch, which contains some of the world's cheapest remaining hydrocarbon stores. The time required to get new projects online has shortened dramatically in the past few years. Costs have fallen, too. Many shale producers now generate cash when oil trades at \$40 a barrel, down from a "breakeven" price of \$80 a barrel a decade ago.

| *Doing frackin' great*

Shale firms made more money last year with oil at \$70 a barrel than they had when prices surpassed \$100 in 2014. Having burned through \$150bn in cash from 2010 to 2020, they will generate cumulative cashflow of nearly \$200bn between 2010 and 2025, reckons IHS Markit. Devon Energy, a big shale operator, has managed to cut its operating expenses in the Permian by nearly a third since 2018. That, plus roughly \$600m in annual savings from a merger with WPX, a rival, has pushed its breakeven point down to as low

as \$30 a barrel, boasts its chief executive, Rick Muncrief.

Mr Muncrief attributes his firm's sparkling stockmarket performance last year—when its shareholder returns approached 200%—in part to its pioneering use of variable dividends, which promise investors both a traditional fixed payout and a share of free cashflow when oil prices surge. Scott Sheffield, Mr Muncrief's opposite number at Pioneer Natural Resources, a rival company, adds that the growth-at-all-costs mindset that led to several shale crashes in the past has been replaced by “a new investor contract”. This puts returning cash to shareholders ahead of debt-fuelled expansion. Moody's calculates that shale producers' ratio of debt to gross operating profit will fall to 1.8 this year, down from 4.4 in 2020.

It could all still come undone. The oil price may crash. Or the companies may revert to their old undisciplined ways. In a report published on January 11th America's Energy Information Administration forecast that shale production will hit a new record in 2023.

For now, though, the American strategy seems to be working, whether or not it is good for the climate. At the start of the year American oil firms' shares were trading at a 69% valuation premium relative to those of their European peers, according to Bernstein. Companies that focus on finding oil and pumping it from the ground have done especially well. An index of such “upstream” firms compiled by Bloomberg, a data provider, shot up by 86% last year, the biggest annual gain since its creation in 1995 and far outpacing the 55% rise in the oil price. This implies that the soaring share prices do not reflect a temporary windfall. For all their low-carbon talk, in other words, investors are not giving up on oil—and American oil bosses know it.

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新一轮大博弈

大石油公司的反弹能持久吗？

美国的石油公司缘何不同？

几乎在世界各地，要求石油行业脱碳的呼声都越来越高，而且不仅仅是来自政府和环保主义者。评级机构穆迪（Moody's）估计，在它评估的1.8万亿美元的全球能源债中，有一半由资产管理公司和保险公司持有，它们对环境、社会和治理（ESG）上面临的压力越来越大，在气候方面尤为突出。波士顿咨询公司（BCG）于1月6日发布了对250家大型机构投资者的年度调查，结果显示超过五分之四的机构认为企业有必要制定长期减排目标。差不多同样比例的机构在把环保设为投资条件方面“感到压力越来越大”。

与此同时，国际预测机构国际能源署（IEA）预计，在2022年，全球石油消费将恢复到疫情前每天一亿桶的水平。即使以后每年增幅不超过1%，按照目前油藏自然衰竭的速度，未来五年必须每天增加1200万至1700万桶的供应才能满足需求，花旗银行的阿拉斯泰尔·赛姆（Alastair Syme）估计。投资者认识到了这一点。在疫情影响最严重的日子过去后，经济于去年重启，油价也开始回升（近期一直在每桶85美元上下浮动，为七年来的高点），在囊括美国大公司的标准普尔500指数中，能源领先于科技和金融，成为表现最好的板块，把环保板块远远甩在了后面（见图表）。

能源与环保之间的角力在上个月于休斯敦举行的世界石油大会（World Petroleum Congress）上展露无余。这是碳氢化合物能源行业三年一度的盛事，有上千人参会，包括各国能源部长、石油公司老板和其他行业的大咖。休斯敦市长西尔维斯特·特纳（Sylvester Turner）在开幕致辞中宣布，“作为世界能源之都，我们负有减少碳排放的道德义务”。在他发言后不久，世界石油巨头沙特阿美（Saudi Aramco）的首席执行官阿明·纳赛尔（Amin Nasser）警告说，如果各国不接受“石油和天然气将在这一转型中发挥重要作用”，将可能出现通货膨胀和社会混乱。从沙特阿美到美国超级巨头埃克森美孚，各家石油公司在展位上竞相展示自己比竞争对手更

低碳。但走一圈下来，也可以看到与会者对勘探和生产资本支出下降感到不安。2019年这些支出为5000亿美元左右，2020年下降到3500亿美元。咨询公司埃信华迈（IHS Markit）的能源专家、普利策奖得主丹尼尔·耶金（Daniel Yergin）警告说，“先发制人式的投资不足”可能会损害世界经济。

| 并不同步

不过仔细去听，这些不一致的声音揭示出大型石油公司在展望下一个十年乃至更长时间时不同的战略考量。欧洲公司越来越多地全力投入绿色发展。沙特阿美等国有控股巨头在静观时机。美国公司则努力在两者之间寻求微妙的平衡。

欧洲公司的做法代表着与过去彻底决裂。它们正在大量剥离石油资产，尤其是污染最严重的资产，押注绿色发电取而代之。去年12月，英国巨头壳牌公司以95亿美元的价格卖掉了它在储量丰富的美国二叠纪（Permian）盆地的页岩油田。2020年10月以来，另一家英国巨头BP和法国公司道达尔能源（Total Energies）分别出售了约30亿美元和23亿美元的资产。

BP的老板伯纳德·鲁尼（Bernard Looney）为公司的转向辩护，坚称“这不是慈善，也不是利他主义”。也许不是吧。但这也不是一门和开采石油一样好的生意。埃信华迈估计，自2010年以来，全球石油和天然气投资的中位年运营回报率为8.3%，而可再生能源为5%。此外，对于石油公司来说绿色能源是一个陌生的领域，它们要面对既有企业的激烈竞争，包括欧洲两大可再生能源巨头沃旭（Orsted）和维斯塔斯（Vestas）。一位分析师称这是“低回报、低悔”策略。

相比之下，国有石油巨头的做法可以概括为“高回报、无悔”。以沙特阿美为首的波斯湾巨头拥有最大的常规石油储量和最低的运营成本。由于地质上的特点，让人意想不到的一点是沙特在石油开采上的碳足迹也是全球最低之一。波斯湾的石油公司在很大程度上不受股东和环保主义者压力的影响，它们在全球石油投资中的份额已从本世纪头几年的约三分之一上升到一半以上。投资公司盛博的鲍勃·布兰克特（Bob Brackett）表示，国有

控股巨头面临的困境是如何能保持高油价而不扼杀需求。

美国的石油公司在财力上没法像波斯湾的石油国家那样有耐心。它们也拒绝像欧洲公司那样彻底撤出原油业务。它们的战略确实涉及一定程度的脱碳，但其核心是努力持续提高开采效率，同时抑制住每当油价上涨就想大笔投资新产能的冲动。

美国公司的脱碳行动与欧洲公司在两个方面有所不同。比起大西洋彼岸的同行，它们未来用于低碳项目的资本支出占比要小得多。同时，这其中的大头不是用于取代碳氢化合物，而是用于限制或抵消公司对气候的影响。

大多数美国大型石油公司都有计划限制油气管道泄漏甲烷这种威力强大的温室气体，并用天然气生产氢这种有前景的清洁燃料。埃克森美孚正在牵头建立一个总投资1000亿美元的碳捕获和储存联盟。分析人士注意到，该公司最近在墨西哥湾浅水区域获得的租约不符合其石油战略需求，但适合储存二氧化碳。西方石油公司（Occidental Petroleum）的野心更大，它正在参与建设世界上最大的“直接空气捕获”工厂，直接从空气中吸收二氧化碳，该工厂将于今年在二叠纪盆地破土动工。“大家已经不争了……气候变化是真实存在的，我们必须想办法解决。”公司老板维奇·霍卢布（Vicki Hollub）态度坚决。

假以时日，这些项目可能会发挥一定作用，帮助收拾石油业有份参与制造的气候乱局。就目前而言，它们仍然只是小插曲，而用一位美国石油老板坦率的说法，是给需要向ESG活动分子弯腰的投资者“提供掩护”。事实上，美国石油公司的股东和管理者都有一个明确的主要目标——从高油价中榨取利润，同时不堕入往往在原油价格高涨后出现的无纪律资本投资。

这一点在美国的页岩油生产商中再明显不过。研究公司标普全球普氏（S&P Global Platts）指出，美国页岩区的生产率和效率有了很大提高，世界上一部分最便宜的尚存碳氢化合物储藏就位于这里。在过去几年中，新项目上线所需的时间已大大缩短。成本也下降了。现在，许多页岩油生产商在石油每桶40美元时也能赚到钱，远低于十年前每桶80美元的“盈亏

平衡”价格。

| 页岩油大热

去年油价每桶70美元时，页岩油公司赚到的钱比2014年超过每桶100美元时还要多。埃信华迈估计，从2010年到2020年，页岩油公司烧掉了1500亿美元现金，它们在2010年到2025年期间的累积现金流将达到近2000亿美元。自2018年以来，大型页岩油公司戴文能源（Devon Energy）已将其在二叠纪盆地的运营费用削减了近三分之一。再加上它与竞争对手WPX合并后每年又节省约6亿美元，其盈亏平衡点已推低至每桶30美元，戴文的首席执行官里克·芒克里夫（Rick Muncrief）自豪地表示。

戴文去年的股市表现亮眼，股东回报率接近200%。芒克里夫认为原因之一是公司开创性地使用了可变股息，除了保证传统的固定派息，在油价飙升时投资者还能分得一部分自由现金流。戴文的竞争对手先锋自然资源（Pioneer Natural Resources）的老板斯科特·谢菲尔德（Scott Sheffield）补充说，不惜一切代价求增长的心态在过去曾导致过几次页岩油崩盘，现在已被“新的投资者合约”取代。后者把向股东返还现金放在举债扩张之前。据穆迪计算，今年页岩油生产商的债务与总营业利润之比将从2020年的4.4降至1.8。

这一切仍可能成为过眼烟云。油价可能会暴跌。或者，这些公司可能再度重蹈过去无纪律投资的覆辙。美国能源信息署（EIA）在1月11日发布的一份报告中预测，页岩油产量将在2023年创下新高。

不过，目前来看，美国石油公司的战略似乎正在奏效——先不论是否对气候有利。盛博的数据显示，今年年初，美国石油公司的股价相对欧洲同行溢价69%。专注陆地石油勘探及开采的公司表现尤其好。数据供应商彭博编撰的一个汇集了此类“上游”公司的指数去年飙升了86%，是自1995年该指数推出以来的最大年度涨幅，远超过油价55%的涨幅。这意味着飙升的股价反映的并不是昙花一现的横财。换句话说，尽管投资者都在大谈低碳，但他们并没有放弃石油，这一点美国石油老板心知肚明。





The future

However justified, more government intervention risks being counterproductive

It is time to reassert the case for less state intrusion

ON THE SURFACE business has seldom had it so good. Profits and share prices are near record levels. Pandemic-relief packages have involved little arm-twisting by governments, and lots of corporate welfare. Megadeals are at an all-time high in America and plentiful elsewhere. What's not to like?

As this special report has argued, quite a bit. Today may turn out to be a high-water mark for business. Almost everywhere people are becoming more mistrustful of it. So are their political representatives. The upshot is that the state wants a greater say over what firms do, where they operate and how they are run. The anti-corporate sentiment makes it harder for businesses to defy calls for new rules or higher taxes.

Some of these are reasonable enough. Profit-seeking enterprises cannot be expected to volunteer to pay more tax or to deal by themselves with such huge challenges as climate change and income inequality, still less geopolitical squabbles. Milton Friedman is reputed to have said that the business of business is business. Companies may need incentives to do the right thing.

But the incentives must spurn favouritism, spur dynamism and maintain openness. And many now being bandied about or enacted do not. Having buried the age of big government under Bill Clinton, Democrats are enthusiastically exhuming it, with even some Republicans cheering them on. Britain's ruling Conservatives have lost their Thatcherite moorings. The EU, a project with a strong interventionist reflex from its inception, is giving in to it. China has moved decisively away from liberalising its

economy into a new era of overt state guidance and control of business.

Political leaders again believe they can pick winners, and some bosses are only too happy to be chosen. Regulators are introducing ever more rules, and using those designed for one goal (promoting competition or good corporate governance) to achieve others (data privacy or workforce diversity). Governments see friendless corporations as a handy piggy-bank. And countries are turning inward, giving international trade the cold shoulder.

| *Dangerous shifts*

These changes carry two dangers. As the state becomes more involved in business, however well-meaning its motives, companies' focus tends to shift from satisfying consumers towards currying favour with political leaders. Preferred firms grow flabbier and less innovative. Regulations dampen animal spirits. Cronyism rears its head. A chosen few win big. Everybody else loses.

The second danger is subtler. As some firms and governments become chummier, others may conclude that they have no choice but to do the same—especially if cosiness seems to work. This could lead to a soft, self-imposed decoupling, even as traditional trade barriers also go up. “You are seeing flows of people, technology, capital all being curtailed,” observes Hank Paulson, America's former treasury secretary. One European industrialist predicts, “The era of shortage will drive more egotism.”

The world has been here before. Post-war state meddling, inspired by the belief that only governments could rebuild societies after 1945 and by the apparent success of central planning, led to flagging dynamism and, by the late 1970s, out-of-control prices and stagnant living standards. It was only in the 1980s, after economic failings in the West and the bankruptcy of the Soviet system both became undeniable, that liberal remedies or freer

markets, lower taxes and greater openness proved more attractive.

China is not doomed to failure as the Soviet Union was. Its economy is more sophisticated and, in pockets, genuinely innovative: look at Alibaba and Tencent, its digital titans. Yet its model is not a superior form of capitalism. For all its progress, China is poor by Western standards, leaving room for state-directed catch-up growth. The most impressive Chinese businesses, including in big tech, have thrived in markets that the state until recently kept mostly at arm's length. In focusing attention on China's top-down policymaking rather than its bottom-up entrepreneurial effervescence, some in the West draw the wrong lessons.

China's course seems set for the foreseeable future. But a swing away from today's interventionist mood remains possible in the West. The Tories may rekindle their inner Thatcher. As a club governed by consensus, the EU may listen more to Nordic liberals when they say "strategic autonomy" is little more than a cloak for protectionism. Clintonian small government may seem a lost cause among Democrats, but Republicans' pro-market memory may kick in if they can only disavow Trumpian populism.

The broad liberal principles rediscovered in the 1980s remain as powerful as they were 40 years ago. For that reason alone, political and business leaders mess with them at their peril. The precepts are also valuable in themselves, as expressions of freedom: for entrepreneurs to invent, consumers to choose and citizens to live as they see fit. That is why it is essential to defend them against attacks from populists, opportunistic cronies in the private sector and those who have lost faith in free markets. For all its imperfections, liberal capitalism remains a vital force for good. ■



未来

无论理由多么正当，更多政府干预可能适得其反

是时候重申减少国家插手的理由了【专题《新干预主义》系列之四】

从表面上看商业很少遇到这么好的时代。利润和股价接近创纪录水平。疫情救助计划包含大量企业福利，政府却甚少从中施压。大额交易在美国处于历史最高水平，在其他地方也很多。有什么理由不喜欢吗？

答案正如本专题已经论述的：相当多。到头来人们可能会发现今天已是商业的最高峰。几乎在世界各地，人们都变得越来越不信任它。他们选出来的政治代表也是如此。结果是政府想要对企业做什么、在哪里做以及怎么做拥有更大的话语权。这种反企业情绪使企业更难反抗要实施新规则或提高税收的呼声。

有些呼吁合情合理。确实不能指望逐利的企业自愿缴纳更多的税，或者自行应对气候变化和收入不平等这样的巨大挑战，更不用说处理地缘政治纷争了。据传米尔顿·弗里德曼曾经说过，企业的营生就是生意。它们可能需要激励机制来做对的事。

但这些激励措施必须摒弃徇私，激发活力，保持开放。而眼下很多被提出讨论或颁布的措施却不是这样。在比尔·克林顿治下埋葬了大政府时代后，民主党人现在正在起劲地挖坟，甚至一些共和党人也从旁鼓劲。英国执政的保守党已经弄丢了撒切尔主义这个指南针。欧盟这个机制自创建之初就带有强烈的干预主义“条件反射”，现在已经完全屈服于这种冲动。中国已经坚决地从经济自由化的道路掉头，进入国家公开指导和控制商业的新时代。

政治领导人再次相信自己可以挑选赢家，有一些企业老板是巴不得被选中。监管机构正在引入越来越多的规则，并用为一个目标（促进竞争或良好的公司治理）设计的规则来实现其他目标（数据隐私或劳动力队伍多样性）。政府把那些“朝中无人”的企业视为方便任意取用的储蓄罐。各国正

在向内转，对国际贸易态度转淡。

| 危险的转变

这些变化带有两种危险。随着国家越来越多地参与商业，无论它是出于多好的本意，企业的关注重点往往会从满足消费者转向讨好政治领导人。被偏爱的企业变得松懈怠惰，创新能力减弱。监管抑制了动物精神。裙带主义开始抬头。被选择的少数人大赢特赢，其他人都输了。

第二类危险更不易察觉。随着一些公司和政府走得更近，其他老板可能会得出结论，自己除了也走这条路外别无选择——尤其是如果关系好看起来确实有用的话。这可能导致自我强加的软脱钩，与此同时传统的贸易壁垒也在上升。“人员、技术和资本的流动都在被抑制。”美国前财政部长汉克·保尔森（Hank Paulson）说。一位欧洲实业家预测，“短缺时代将推动更多的自我主义。”

世界以前就曾如此。二次世界大战后人们相信只有政府才能重建社会，加上中央计划模式取得明显成功，促使国家大力干预，结果经济活力减弱，到了七十年代后期物价失控，生活水平停滞不前。直到八十年代西方经济失败和苏联体制破产都已摆在眼前无可否认，自由主义补救措施——更自由的市场、更低的税收和更多的开放才变得更具吸引力。

中国不一定会像苏联那样失败。它的经济更加复杂，而且在部分领域还具有真正的创新性：看看它的数字巨头阿里巴巴和腾讯。但是，它的模式并不是资本主义的高级形式。尽管取得了非凡的发展，但按西方标准衡量中国仍是穷国，这给国家主导的追赶式增长留下了空间。最令人印象深刻的中国企业（包括大型科技公司）得以蓬勃发展的市场，是直到最近国家都基本上保持了距离的市场。西方一些人把注意力集中在中国自上而下的政策制定，而不是自下而上的创业热情上，由此得出了错误的经验。

中国的路线在可预见的未来似乎已经确定。但西方仍有可能摆脱今天的干预主义情绪。托利党人可能会重新激活内在的撒切尔。当北欧的自由主义者说“战略自治”不过是保护主义的外壳时，欧盟这个靠共识治理的俱乐部

可能会听进去。克林顿式的小政府在民主党人之中看来可能已无机会实现，但如果共和党人能和特朗普式民粹主义划清界限，他们可能会重新记起自己亲市场的往昔。

在1980年代被重拾的宽泛的自由主义原则仍像40年前那样强大。仅仅出于这一个原因，违背这些原则的政治和商业领袖是在冒险。这些原则本身就有其价值，它们是对自由的表达：企业家发明的自由；消费者选择的自由；公民按自认为合适的方式生活的自由。这就是为什么必须保护它们免受民粹主义者、私营部门的机会主义朋党以及对自由市场失去信心的人们的攻击。尽管存在各种缺陷，自由资本主义仍然是一股向善的关键力量。





Competition policy

The growing demand for more vigorous antitrust action

Greater concentration of market power is leading to a trustbusting revival

OBSERVERS OF CHINA'S rise have grown used to seeing old edifices bulldozed to make way for the new. As with bricks and mortar, so with intellectual constructs. In just 12 months President Xi Jinping has replaced a "cautious and tolerant" approach to the private sector with something much less so. Nowhere has the shift towards tougher rules and enforcement been more striking than in competition policy.

A year ago the Communist Party's body for political and legal affairs vowed to take trustbusting more seriously. Within months China revised its antitrust law of 2008, increasing sanctions and agencies' discretion. The State Administration for Market Regulation (SAMR), the antitrust watchdog, has blocked mergers and, says Angela Zhang of Hong Kong University, levied fines totalling \$3.7bn on tech giants for sins ranging from price discrimination to merchant abuse. The agency's antitrust bureau is more than doubling in size, from 40 to 100 officials, and it plans to expand to 150.

Chinese bureaucrats have used state media to arouse outrage against firms' abuse of market power, enough to clobber a miscreant's sales and share price. Despite having no overt antitrust role, the People's Bank of China uses financial regulation and its bully pulpit to cow payments firms. Tencent and Alibaba, two tech titans with a payments duopoly, are being forced to drop the model in which shopping and payments are exclusive to one platform. In moves ostensibly aimed at curbing big tech, the National Press and Publication Administration has prohibited children from playing more than three hours of video games a week most of the year. Another agency barred Didi Global from Chinese app stores for data violations, days after the ride-hailing firm went public in New York before later shifting to

Hong Kong.

Such actions mark a departure from the antitrust philosophy that has dominated regulatory thinking and judicial decisions in the past half-century. Associated with Robert Bork, an American judge from the late 1970s, it held that consumer welfare and the protection of competition, rather than of particular competitors, should be the only goals of antitrust law. Business practices were deemed fine so long as they did not result in harm to consumers from excessive prices. Most mergers were either competitively neutral or enhanced efficiency, even if they led to oligopoly; only those creating a dominant firm or monopoly were likely to be bad for consumers.

Bork's work was itself a reaction to an earlier approach linked to Louis Brandeis, a former US Supreme Court justice. Brandeis believed that size was nefarious in itself. Curbing market power was a tool to fight other ills, such as mistreatment of workers, the stiffing of suppliers or even threats to democracy. This may have led to some perverse outcomes. In one notorious example in 1966, the Supreme Court blocked a merger between two grocers in Los Angeles with a combined market share of 8%.

Chinese trustbusters are now the most enthusiastic in disavowing the price-centricity of Bork's "consumer-welfare standard". But it has fallen out of favour everywhere, gradually in Europe and now, tentatively, in America. One reason is a global trend towards greater corporate concentration, from medicines to manufacturing. According to The Economist's calculations, two-thirds of 900-odd sectors covered by America's economic census became more concentrated between 1997 and 2012. In half of these concentration has edged up further in the subsequent five years. In the two decades to 2017 the weighted average market share of the top four firms in each industry increased from 26% to 32%. The four biggest British firms accounted for a larger share of revenue in 2018 than a decade earlier in 58%

of 600-odd subsectors. Concentration in the EU has been going in the same direction, albeit more slowly.

Another good reason to bin Bork was technological change. The world's biggest tech giants charge consumers either nothing (Alphabet, Google's parent company, and Meta, formerly Facebook) or as little as possible (Amazon). Critics say this does not stop them abusing their dominance. Amazon is attacked for its treatment of workers, suppliers and third-party sellers. Google and Apple are accused of monopolistic practices against developers in their app stores. Facebook is taken to task for "killer acquisitions" aimed at neutralising innovative challengers such as Instagram and WhatsApp. (All four companies deny all these claims.)

| *Choice and quality*

"We need to push for a broader notion of consumer harm," declares Margrethe Vestager, the EU's competition commissioner. It is no excuse that "the econometrics of price may be more straightforward than the econometrics of quality and choice", she adds. Britain's Competition and Markets Authority (CMA) has made similar noises. Like China's SAMR, it is staffing up fast, going from around 650 officials to 850 in the past five years, catching up with Ms Vestager's directorate-general.

Antitrust voices in America go further, arguing that the consumer-welfare standard was never as scientific as its advocates claimed and that Brandeis's vision deserves a second look. Mr Biden has installed "neo-Brandeisians" in senior trustbusting roles. Lina Khan, a 32-year-old academic, chairs the Federal Trade Commission (FTC). Jonathan Kanter, a long-time Google-basher, heads the Department of Justice (DoJ)'s antitrust division. Tim Wu, a law professor whose books include "The Curse of Bigness", is the White House adviser on technology and competition. "The speed of the takeover by the neo-Brandeisians of the regulatory apparatus has been extraordinary," says one big asset manager.

This new competition doctrine remains a work in progress. But its contours are becoming sharper. It expands the goals of antitrust policy in two main areas: merger control and business-model regulation. For most mergers and acquisitions (M&A), regulators used to restrict scrutiny to a small number of “horizontal” deals between firms active in the same market that, if combined, could reduce competition and allow incumbents to raise prices. Today all these tenets are going out of the window.

Trustbusters now investigate “vertical” integrations between companies with separate lines of business, as well as horizontal ones with combined revenues that would not historically have warranted attention. A new procedure allows EU regulators to ask national authorities to submit deals that are potential killer acquisitions, particularly in the digital, pharma and biotech industries. They have used this to investigate Meta’s \$1bn acquisition of Kustomer, an American business-software firm with low European sales, and the purchase by Illumina, a gene-sequencing giant, of Grail, a developer of diagnostic tests that does no business in the EU. Germany’s competition authority has been pushing cases like Illumina “to test its jurisdiction”, says an EU official. Britain’s CMA has demanded that Meta undo its recent takeover of Giphy, a database of animated GIF files.

In America the FTC and DoJ are making merger guidelines more stringent. M&A lawyers say the agencies are asking more questions, including about the impact of deals on the labour market. They already look beyond direct pecuniary harm to consumers. The FTC is backing a suit that seeks to break up Meta into Facebook, Instagram and WhatsApp, even though earlier regulators waved these takeovers through. Justifying its challenge to a merger between Simon & Schuster and Penguin Random House, the Do J said it would give the new entity “outsized influence over who and what is published, and how much authors are paid for their work”. Ms Khan is expected to oppose Amazon’s \$8.5bn purchase of MGM Studios, arguing that it would further strengthen the e-empire’s online hegemony. The fact

that the entertainment market is fragmented and Amazon lets Prime-subscription customers binge-watch its videos for a fixed fee is, on this expansive view of antitrust, beside the point.

The second avenue of antitrust expansion—dictating what dominant businesses can and can't do—is more inchoate than tougher merger control. But it could prove more consequential. Especially for America's trillion-dollar tech giants it would be the first serious constraints on their activities since the internet made them the world's most valuable companies.

Some edicts come from regulatory agencies. White House staff look on antitrust as a “Swiss-army knife”: a tool to fix lots of different problems, including such ills as inflation. It is early in Mr Biden's term and they are still revving up, says one lobbyist. But “once they start going, they will be pretty muscular.” Last July Mr Biden issued an executive order, written by Mr Wu, instructing more than a dozen agencies vigorously to curb anticompetitive behaviour across the economy. It encourages agencies to create rules from weeding out “unfair methods of competition on internet marketplaces” to requiring railway owners “to provide rights of way to passenger rail”. In a memo outlining her priorities, Ms Khan declared that she would look into whether private-equity firms contribute to extractive business models in which companies raise prices or muscle out rivals.

The 107-year-old FTC Act grants Ms Khan wide latitude, so long as her rules are designed to forestall “conduct that is unfair or deceptive”. Congress may grant her even more power. Several proposals would outlaw practices deemed anticompetitive. One would treat Amazon's marketplace or Google's search engine as essential to commerce, rather like a dominant railway operator, prohibiting them from favouring their own products over others. Another would force Apple and Google to open up their app stores to alternative in-app payment methods and search results. A third would

shift the burden of proof from regulators to dominant companies, which would need to show that any merger or acquisition does not hurt competition, rather than the other way around. All three have Democratic and Republican co-sponsors.

Other places are further along the regulatory route. The EU is preparing to adopt two laws, the Digital Markets Act and the Digital Services Act. South Korea has enacted one that eliminates app stores' monopoly on payments. Britain is considering new rules, including on self-preferencing by large platform companies.

| *If in doubt, litigate*

Unlike their Chinese counterparts, Western businesses will not take this lying down, let alone vow “comprehensive self-examination and rectification”, as Meituan, a food-delivery giant, did after being fined \$530m by SAMR in October. America's tech giants are deploying high-powered lobbyists to scupper or water down rules before they see the light of day. In November the US Chamber of Commerce sent three strongly worded letters to the FTC accusing Ms Khan of overstepping her brief and dismantling procedural safeguards at the agency. It will be “active in litigating”, vows Mr Bradley, its policy chief.

Meta, Illumina and Penguin Random House are fighting regulators in court. Judges used to the consumer-welfare standard may resist attempts to redefine it. Corporate lawyers will remind them that, by prioritising outcomes other than price, the neo-Brandeisians “want people to pay for [their] policy preferences”, as the chief counsel at a big tech firm puts it.

Big firms argue that, as they expand into adjacent markets, they increasingly compete with one another. This is especially true of big tech, whose rise has fuelled the Brandeisian revival. Amazon is the third-biggest online advertiser behind Alphabet and Meta. Apple is building a search

engine to challenge Google. Google's cloud-computing division is taking on Amazon Web Services and Microsoft's Azure. Meta is getting into e-commerce. The research papers cited in Mr Biden's executive order date back half a decade. Concentration in America may since have plateaued.

This resistance ensures that the competition authorities' multipronged assault on big business will take time to play out. The new trustbusting zeal also rubs up against a rekindled affection for national champions, which are by definition big and powerful. European bosses urge Ms Vestager to take into account how competitive global markets are, not just the EU's, when deciding on mergers. The single-market commissioner, Mr Breton, is receptive to such ideas. Even Ms Vestager, who ignored Franco-German calls to permit the creation of the Alstom-Siemens rail champion, now speaks warmly of the battery consortium.

That may be why, for all the antitrust commotion, M&A activity remains strong in Europe and America, as companies take advantage of cheap capital and a surfeit of pandemic-distressed targets. Chinese tech titans have shed a collective \$1.4trn in stockmarket value since China started turning the screws on them in earnest last February. America's five biggest tech firms have added \$2.1trn in the same period. The neo-Brandeisians may have "achieved political success prematurely", suggests Mr Furman from Harvard.

Yet bosses, lobbyists and corporate lawyers acknowledge that a chill has descended as regulators test their powers. The dealmaking frenzy may partly reflect a desire to get in under the wire. Without clear rules, companies no longer know when to notify regulators about a deal and must think about competition from the outset. One lobbyist claims that clients with deals pending at the FTC are not getting answers. They may face an investigation halfway through a deal or even after it closes—and in a growing number of jurisdictions. Just one hold-out can put paid to a

merger. In March 2021 Applied Materials, an American semiconductor company, scrapped its acquisition of a Japanese rival, which had been approved in America, Europe and Japan, but not in China. Boeing got clearance to merge parts of its business with Embraer, a Brazilian planemaker, everywhere except Europe.

The uncertainty over mergers and rules that might curtail certain practices adds hassle, risk and cost to potential deals. Some business decisions that might once have been made will now never be considered. Value not created as a result is impossible to quantify, but it is surely there. ■



竞争政策

对更强有力的反垄断行动的需求日益增长

市场力量更趋集中正导向反托拉斯复兴【专题《新干预主义》系列之三】

观察中国崛起的人们已经对推倒旧楼给新大厦腾地的景象习以为常。钢筋水泥的楼房是如此，思想建构也一样。在短短12个月里，中国国家主席习近平已经推翻了对私营部门“包容审慎”的监管思路，朝着相反的方向大步迈进。没有什么比竞争政策更能体现这种向更严苛的规则和执行的转变了。

一年前，中共中央政法委誓言要加强反垄断。几个月内，中国修订了2008年实施的反垄断法，加大处罚力度并扩大了政府机构的自由裁量权。香港大学的张湖月说，国家反垄断监管部门市场监管总局已经否决了一些合并案，并就价格歧视和欺压小商户等各种问题对科技巨头处以总计37亿美元的罚款。总局下属的反垄断局规模扩大了一倍多，从40名官员增至100名，并计划继续扩编至150名。

中国官员利用官方媒体激起公众对企业滥用市场支配地位的愤怒，足以重挫涉事企业的销售额和股价。尽管并不具有公开的反垄断职能，中国人民银行借金融监管和自身地位威吓支付公司。两大科技巨头腾讯和阿里巴巴在支付业务上形成双头垄断，如今正被迫放弃相互屏蔽购物和支付的模式。在表面上为遏制科技巨头的各种行动之中，国家新闻出版署规定在一年绝大部分时间里，未成年人每周玩电子游戏不得超过三小时。网约车公司滴滴出行刚在纽约上市了几天，另一个政府机构就以数据违规为由将其从中国的应用商店下架。之后滴滴开始准备转至香港上市。

这类行动标志着中国正在背离过去半个世纪以来主导全球监管思维和司法决策的反垄断理念。这一理念由1970年代末的美国法官罗伯特·博克

（Robert Bork）提出，主张消费者福利和保护竞争——而非保护特定的竞争者——应是反垄断法的唯一目标。商业行为只要不导致以过高的价格损害消费者就没问题。大多数合并要么是无关竞争，要么提高了效率，即便

它们导致了寡头垄断；只有那些打造出一家独大局面的合并才很可能对消费者不利。

博克的理论本身又反驳了早先前最高法院大法官路易斯·布兰代斯（Louis Brandeis）主张的理念。布兰代斯认为，规模本身就是邪恶的。遏制市场支配力是对抗其他弊病的工具，例如虐待工人、压榨供应商甚至威胁民主。这种思路可能导致了一些不合情理的结果。一个臭名昭著的例子是最高法院在1966年阻止了洛杉矶的两家食品杂货店合并，而它们的市场份额加起来不过区区8%。

中国的反垄断官员现在对推倒博克专注价格的“消费者福利标准”最为积极。但这项标准在世界各地都已失宠：欧洲逐渐抛弃它，而眼下美国也开始尝试转向。背后原因之一是从药品到制造业的全球产业集中度提高的趋势。根据本刊计算，美国的经济普查所涵盖的900多个部门中，有三分之二在1997年至2012年间变得更加集中。这三分之二之中又有一半在接下来的五年里进一步集中。在截至2017年的二十年间，每个行业前四大公司的加权平均市场份额从26%提高到32%。2018年，英国600多个细分行业中，有58%的行业的前四大公司所占收入份额比十年前更大。在欧盟，行业集中度朝着同样的方向发展，尽管速度要慢些。

抛弃博克的另一个理由是技术变迁。全球最大的一批科技巨头要么不向消费者收取任何费用（谷歌的母公司Alphabet，和前身为Facebook的Meta），要么收取尽可能少的费用（亚马逊）。批评人士说这并不妨碍它们滥用自己的支配地位。亚马逊因其对待工人、供应商和第三方卖家的方式受到攻击。谷歌和苹果被指在自己的应用商店中对开发者施加垄断行为。Facebook被指斥开展“杀手式收购”以消除Instagram和WhatsApp等创新挑战者的威胁。（四家公司全都否认了所有这些指控。）

| 选择与质量

“我们需要推动更广义的消费者伤害概念。”欧盟竞争事务专员玛格丽特·维斯塔格（Margrethe Vestager）宣称。“价格的计量经济学或许比质量和选择的计量经济学更一目了然”这一点不应是借口，她补充道。英国竞争

与市场管理局（CMA）也发出了类似的声音。和中国的市场监管总局一样，CMA正在迅速增加人手，过去五年里从大约650名官员增加到850名，赶上了维斯塔格带队的欧盟竞争总司。

美国的反垄断声势更进一步，指出消费者福利标准从来都不像其倡导者声称的那般科学，而布兰代斯的理念值得重新审视。拜登已经在反垄断高级职位上安排了“新布兰代斯派”。32岁的学者莉娜·汗（Lina Khan）出任联邦贸易委员会（FTC）主席。长期炮轰谷歌的乔纳森·坎特（Jonathan Kanter）出任司法部（DoJ）反垄断部门负责人。著有《巨头的诅咒》（The Curse of Bigness）等书的法学教授吴修铭出任白宫技术和竞争顾问。“新布兰代斯派接管监管部门的速度非常惊人。”一家大型资产管理公司表示。

新的竞争原则仍未定型，但它的轮廓日渐清晰。它在两个主要方面扩展反垄断政策的目标：兼并控制和商业模式监管。对于大多数并购案，监管机构过去将审查局限在活跃于同一市场的公司之间发生的少数“横向”交易上，如果其合并可能减少竞争并允许既有企业抬高价格的话。今天，所有这些基本原则被抛向九霄云外。

如今反垄断官员调查具有不同业务线的公司之间的“垂直”整合，以及合并营收额在过去并不需要关注的横向整合。一项新程序让欧盟监管官员可以要求成员国当局上报潜在的杀手式收购，特别是在数字、制药和生物技术行业里的交易。他们据此调查了Meta以10亿美元收购在欧洲销售额很低的美国商业软件公司Kustomer，以及基因测序巨头Illumina收购在欧洲并无业务的诊断测试开发商Grail。一位欧盟官员表示，德国的竞争主管部门一直在推动审查Illumina这样的案子来“测试其管辖权”。英国的CMA要求Meta撤销其最近对GIF动画文件数据库Giphy的收购。

在美国，FTC和司法部正在制定更严格的合并准则。并购律师表示，这些机构正在提出更多问题，包括交易对劳动力市场的影响。它们关注的点已经超越了对消费者的直接金钱损害。FTC支持的一项诉讼寻求把Meta拆分为Facebook、Instagram和WhatsApp，尽管之前的监管机构已经批准了这

些收购。司法部对西蒙与舒斯特（Simon&Schuster）和企鹅兰登书屋的合并计划提起诉讼，理由是合并后的新实体将获得“在选择出版谁的作品、什么内容，以及支付作者多少报酬上的过度影响力”。外界预期莉娜·汗将反对亚马逊以85亿美元收购米高梅，她会说这将进一步加强这个电子帝国的网上霸权。在这种扩展的反垄断理念中，娱乐业市场仍很分散以及亚马逊让其Prime订户以固定费用任意收看视频的事实都无关紧要了。

反垄断扩张的第二条途径是规定占主导地位的企业能做什么，不能做什么。相比收紧合并控制，这方面还处于起步阶段。但它可能产生更重大的影响。特别是对美国价值万亿美元的科技巨头来说，这将是互联网让它们成为世界上最有价值的公司以来，头一回被真正限制经营活动。

一些规定来自监管机构。白宫班子把反垄断看作“瑞士军刀”：一种能解决许多不同问题的工具，包括通胀这样的弊病。一位说客说，目前还是拜登任期的早期，他们还在热身中。但“一旦他们开始行动，将会非常强硬。”去年7月，拜登发布了吴修铭起草的行政令，大力指示十多家机构在经济的方方面面遏制反竞争行为。它鼓励机构制定各种规则，从清除“互联网市场上的不公平竞争方式”，到要求铁路所有者“提供客运铁路通行权”等。莉娜·汗在一份概述她的工作优先事项的备忘录中宣布，她将审视私募股权公司是否有助于榨取式经营模式，让企业得以抬高价格或强行驱逐竞争对手。

有107年历史的《联邦贸易委员会法》（FTC Act）赋予莉娜·汗很大的自由度，只要她制定的规则旨在预防“不公平或欺骗性的行为”。国会可能会授予她更多权力。一些提案将把一些被视为反竞争的做法列为非法。其中一项提案把亚马逊的平台市场或谷歌的搜索引擎定性为商业必需品，就像主导的铁路运营商那样，据此禁止它们特别照顾自家产品。另一项将迫使苹果和谷歌在自家应用商店中纳入其他应用内支付方式和搜索结果。第三项提案将举证责任从监管机构转移到主导企业，需要由后者证明自己的任何并购交易都不会削弱竞争，而不是反之。这三项提案都有两党的提案人。

其他地方在监管的路线上走得更远。欧盟正准备通过两项法律：《数字市场法》和《数字服务法》。韩国颁布了一项法案，以消除应用商店对支付的垄断。英国正在考虑新的法规，包括约束大型平台企业偏袒自家产品。

| 法庭上见

与中国同行不同的是，西方企业不会乖乖接受这一切，更不会像外卖巨头美团在10月被市场监管总局罚款5.3亿美元后那样发誓“全面自查整改”。美国的科技巨头正在部署强大的游说队伍，要把新规则扼杀在摇篮中或让它们大打折扣。11月，美国商会（US Chamber of Commerce）向FTC发出三封措辞强硬的信函，控诉莉娜·汗在该机构越权及破坏程序保障。其政策主管布拉德利誓言商会将“积极兴讼”。

Meta、Illumina和企鹅兰登书屋正在法庭上与监管机构斗争。习惯了消费者福利标准的法官们可能会抵制重新定义它的尝试。公司律师会提醒他们，如果把其他结果摆在价格之前，新布兰代斯派——用一家科技巨头的首席法律顾问的话说——“要人们为[他们的]政策偏好付费”。

大公司辩称，随着自己向相邻市场扩张，它们之间的竞争越来越激烈。这一点对科技巨头尤其适用，而正是它们的崛起推动了布兰代斯派的复兴。亚马逊是仅次于Alphabet和Meta的第三大线上广告商。苹果正在构建一个搜索引擎来挑战谷歌。谷歌的云计算部门正向亚马逊AWS和微软Azure宣战。Meta正在打入电子商务。拜登的行政令中引用的研究论文发表于五年前，而自那时以来，美国的行业集中度可能已趋于稳定。

这种抵抗确保了竞争管理部门对大企业的多线进攻将需要时间才能看到结果。这股新兴的反托拉斯热也与对国家领军企业重燃的热情相抵触——领军企业自然是大而强的。欧洲的老板们敦促维斯塔格在审议合并案时考虑全球市场的竞争度，而不仅仅是欧盟市场。单一市场专员布雷顿对这种看法还比较接纳。即使是维斯塔格，虽然之前曾无视法德两国让阿尔斯通和西门子合并创造铁路领军企业的呼吁，现在也在热情地谈论着打造电池联盟了。

这可能就是为什么尽管反垄断的雷声如此之大，欧洲和美国的并购活动却依然活跃：企业抓住机会利用廉价资本，还有大量因疫情陷入困顿的收购目标。自中国于去年2月开始奋力打压自己的科技巨头以来，它们的股票市值累计已缩水1.4万亿美元。同一时期美国最大的五家科技公司增值了2.1万亿美元。哈佛的弗曼表示，新布兰代斯派可能“过早地取得了政治上的成功”。

不过，老板、游说者和公司律师承认，随着监管机构测试自己的权力上限，一股寒意已经袭来。眼下的交易热在一定程度上可能是因为大家急着要搭上末班车。没有明确的规则，企业不再清楚何时该就交易通知监管部门，并且必须从一开始就考虑竞争问题。一位说客声称，其客户在FTC的待批交易得不到任何回复。它们可能会在交易进行到一半甚至完成后受到调查——而且是在越来越多司法辖区被调查。只要有一个辖区不通过就可以让一宗合并交易流产。2021年3月，美国半导体厂商应用材料公司（Applied Materials）取消了对一个日本竞争对手的收购，该交易已在美国、欧洲和日本获批，在中国没有。波音原本计划将部分业务与巴西飞机制造商巴西航空工业公司（Embraer）合并，在各地都已获准，唯欧洲除外。

围绕合并的不确定性和可能限制某些操作的法规增加了潜在交易的麻烦、风险和成本。一些在过去可能会做出的商业决策如今绝不会被考虑。因此而未被创造的价值无法量化，但肯定存在。 ■



Corporate taxes

The long trend of falling corporate taxes is being reversed

After falling for decades, taxes on companies are rising again

FOR WORLD peace, the League of Nations was an abject failure. For companies, it has proved a great success. In the 1920s it set a basis for corporate taxation that has endured ever since. Recognising that taxing profits in different places can hurt trade and growth, rights to tax were allocated first where profits are generated and only second where a company sites its headquarters.

This principle has now been enshrined in bilateral tax treaties—with unintended consequences. Governments have realised they can lure investment with lower tax rates. Between 1985 and 2018 the average corporate-tax rate fell from 49% to 24%. Many tax havens charge zero. The idea has grown that collecting taxes from rapidly growing, efficient firms is “whipping the fast ox”.

Companies have also learned to pay less tax by shifting reported earnings, which is easier with the rise of intangible assets such as brands. Although only 5% of American multinationals’ foreign staff work in tax havens, they book nearly two-thirds of foreign profits there, twice as much as in 2000. In 2016 around \$1trn of global profits were booked in “investment hubs” such as the Cayman Islands, Ireland and Singapore, whose average effective tax rate on profits is 5%. According to an OECD study in 2015, this robbed public coffers of \$100bn-240bn a year, equivalent to 4-10% of global corporate-tax revenues.

Some action to improve and simplify corporate taxation was long overdue. But with business fast going from sacred ox to whipping boy, governments have become less concerned with creating a better system and more with

just getting firms to pay more tax. Britain has decided to raise its corporate-tax rate from 19% to 25%, becoming only the second OECD country to do so since 2000 (the first, Chile, has reversed its decision). In America moderate Democrats stopped Joe Biden undoing his predecessor's tax reform, which cut the corporate-tax rate from 35% to 21%. But his Build Back Better bill floated a tax on share buybacks and an excise tax of 95% on sales of drugs for which drug firms refused to negotiate prices with the Medicare system.

The bill would also have raised the minimum rate that American multinationals pay on global profits from 10.5% to 15%. This could have raised an extra \$30bn a year. It would also have aligned America with a new tax pact negotiated through the OECD. Fully 136 countries have signed up to a 15% global minimum rate, and allocated more taxing rights from where companies book profits to where they make sales. The OECD hopes to get this deal into force in 2023. Mr Furman, the former economic adviser to Barack Obama, calls it "a real sea change" in how companies are taxed. Others throw around terms like "once in a century" and "revolution".

The reallocation of taxing rights will apply only to companies with global turnover above €20bn (\$24bn), and only on pre-tax profits exceeding 10% of revenues. It is likely to raise a "modest amount", thinks Michael Devereux of Oxford University's Saïd Business School. Some estimates put it at a trifling \$5bn-12bn a year worldwide. Mr Devereux reckons the global minimum may raise an extra 4-5% on top of what companies already pay, or around \$100bn annually.

Yet this underplays the significance of the shift. The reallocation affects some 110 multinational groups, says David Bradbury of the OECD. Most are American. They probably include the usual suspects such as Apple and Amazon, which have perfected the art of tax optimisation. These firms face a costly and tedious unwinding of their tax arrangements—and a higher overall bill. As for the global minimum, Mr Bradbury expects countries and

companies to alter their behaviour. Switzerland, which supports the pact, is murmuring about new tax incentives to remain attractive. “It will be messy,” sums up an executive at one American multinational.

Companies might once have kicked up a fuss over the OECD deal. They have thought better of it, given intensifying anti-business sentiment. Some have even praised the harmonisation effort. In private, though, executives grumble that the OECD plan is “a convenient vehicle” to raise taxes at home. That, says one tech boss, is what Mr Biden is doing. Neil Bradley of the US Chamber of Commerce warns of moving from a race to the bottom to “a race to the top”. If tax authorities believe they will avoid leakage, he says, they may conclude “We can tax as much as we want.” Mr Devereux would not be surprised if corporate taxes creep up.

There may be more unintended consequences. One mysterious feature of the 40-year slide in corporate-tax rates has been that companies’ contribution to public coffers has remained flat in rich countries, at about one-tenth of the tax take, or 2-3% of GDP. In poorer ones the figures are slightly higher but equally steady. Analysts put this down to more firms paying tax, corporate profits growing and wealthy individuals using companies to reclassify highly taxed personal income as lower-taxed corporate income.

The base of payers looks unlikely to dwindle. Once known to taxmen, firms rarely extricate themselves from their grasp. How the changes affect profits is harder to judge. Experts do not expect the overhaul to dampen pre-tax profits, though that could happen if higher rates discouraged investment. Some signatories to the deal may retain their edge with offsetting sweeteners such as lower taxes on individuals or property.

There are also unknown unknowns which may become clearer only once firms have adjusted. Two things can be predicted. A bonanza awaits tax

lawyers and accountants. And the new equilibrium will be less favourable to companies. One boss of a big multinational company suggests that the tax system is the ultimate test of what countries care about. The implication is that they care less than before about keeping business happy.





企业税

企业税下降的长期趋势正在逆转

在下降数十年后，对公司的税收再次上升【专题《新干预主义》系列之二】

就世界和平而言，国际联盟是个彻头彻尾的失败。对于公司来说，它却成了一个巨大的成功。在1920年代，它为自那以后一直存在的公司税收奠定了基础。认识到在不同地方对利润征税可能会损害贸易和增长，税收权首先分配给产生利润的地方，然后才分配给公司总部所在地。

这一原则现已载入双边税收协定，却导致了意想不到的后果。政府意识到自己可以用较低的税率吸引投资。从1985年到2018年，平均公司税率从49%下降到了24%。许多避税天堂税率为零。越来越流行的看法是，从快速增长的高效率企业征税相当于“鞭打快牛”。

公司还学会了通过转移报告的收益来减少纳税，这一点随着品牌等无形资产的兴起变得更容易了。尽管美国的跨国公司中只有5%的外籍员工在避税天堂工作，但他们却在那里登记了近三分之二的海外利润，这一比例是2000年的两倍。2016年，全球有约1万亿美元的利润被记入了“投资中心”，例如开曼群岛、爱尔兰和新加坡，它们对利润征收的平均有效税率是5%。根据经合组织2015年的一项研究，这每年从国库劫走了1000亿至2400亿美元，相当于全球企业税收入的4%到10%。

早就应该采取一些改善和简化公司税收的行动了。但随着企业迅速从圣牛变成替罪羊，政府已经不那么关心创建一个更好的税收制度这件事，而更多地关心如何让公司多缴税就好。英国已决定将其公司税率从19%提高到25%，成为自2000年以来第二个加税的经合组织成员国（第一个是智利，但已经撤销了决定）。在美国，温和派民主党人阻止了拜登取消其前任将公司税率从35%降至21%的税制改革。但他的“重建更好未来”法案对股票回购征收税款，并对制药公司拒绝与联邦医疗保险系统（Medicare）协商价格的那部分药品销售征收95%的消费税。

该法案还将美国跨国公司就全球利润支付的最低税率从10.5%提高到15%。这可以每年额外筹集300亿美元。它还将使美国与经合组织谈判达成的一项新税收协定保持一致。有136个国家已经签署了15%的全球最低税率，并把更多的税收权利从公司记录利润的地点转移到销售地点。经合组织希望让该协议在2023年生效。奥巴马的前经济顾问弗曼称其为公司征税方式带来了“真正的巨变”。其他人则使用了“百年一遇”和“革命”等说法。

税收权的重新分配将仅适用于全球营业额超过200亿欧元（240亿美元）的公司，并且仅适用于税前利润超过收入10%的公司。牛津大学赛德商学院的迈克尔·德弗罗（Michael Devereux）认为，这可能会筹集到“不太高的金额”。一些估计认为全球每年在微不足道的50亿至120亿美元左右。德弗罗认为，全球最低税率可能会在公司已经支付的税收基础上再增加4%到5%，即每年约1000亿美元。

然而，这低估了这种转变的重要性。经合组织的大卫·布拉德伯里（David Bradbury）说，重新分配影响了大约110个跨国集团。它们大多数是美国公司。其中很可能会包括一些通常的怀疑对象，例如苹果和亚马逊，它们已经把税收优化的艺术玩得炉火纯青。这些公司面临着拆解自己的纳税安排这一昂贵又繁琐的工作——以及数额更高的整体账单。至于全球最低税率，布拉德伯里预期各国和公司会改变行为。支持该协议的瑞士正在琢磨着新的税收激励措施以保持自身吸引力。“将会是一团糟。”一家美国跨国公司的高管总结道。

要放在以前，公司可能会对经合组织这项协定大为光火，但鉴于反商业情绪愈演愈烈，它们决定还是保持克制为妙。一些公司甚至赞扬了这项协调工作。不过，高管们私下抱怨说，经合组织的计划是在国内增税的“便捷工具”。一位科技公司老板说，这就是拜登正在做的事情。美国商会的尼尔·布拉德利（Neil Bradley）警告会出现从竞相降税转变为“竞相增税”的局面。他说，如果税务机关认为自己能够阻止税收泄漏，可能就会得出结论：“我们可以随心所欲地征税。”如果公司税节节攀升，德弗罗不会感到惊讶。

可能会有更多意想不到的后果。公司税率下滑了40年，却伴随一个奇怪的特征：富裕国家的公司对公共财政的贡献保持不变，约为税收的十分之一，或GDP的2%到3%。这个数字在较贫穷的国家略高，但同样稳定。分析师将此归结为更多公司纳税、公司利润增长，以及富人利用公司把高税收的个人收入重新归类为低税收的公司收入。

纳税的公司基数看起来不太可能减少。一旦入了税务人员法眼，公司很少能逃出他们的掌心。这些变化会如何影响利润就不大好说了。专家们预计改革不会抑制税前利润，尽管如果更高的税率阻碍了投资，这种情况也有可能发生。该协定的一些签署国可能会给一些甜头来保持优势，例如降低个人税或财产税。

还有一些未知的未知因素，只有在公司做出调整后才会变得更加清晰。有两件事是可以预测的。税务律师和会计师肯定会财源滚滚。新的平衡局面对公司不那么有利。一家大型跨国公司的老板认为，税收制度是检验各国关心什么的最终标准。言下之意是，它们比以前更不在意让商界高兴了。





The new industrial policy

Many countries are seeing a revival of industrial policy

A previously discredited approach has found new believers

AS NATIONAL ECONOMIES and international trade were liberalised after the stagflation of the late 1970s, governments increasingly decided to allow corporate behaviour to follow commercial logic. Multinationals set up shop where it made most sense, allocating resources, outsourcing labour and automating factories to minimise costs and maximise profits. The reforms lifted hundreds of millions out of poverty even as they delivered fat returns for shareholders.

But the less-state-is-better consensus is fraying. The crash of 2008, the loss of middle-class jobs to foreigners or robots and the climate crisis have led many to believe that markets cannot be trusted. Economists like Mariana Mazzucato, of University College London, believe that firms are losing the ability to innovate, weighing on future prosperity. National-security hawks on both sides of the Sino-Western divide fret about reliance on adversaries for critical resources, from semiconductors to pharmaceuticals. And Western bosses complain about “unfair competition” from China’s state-backed behemoths.

“We have been destroying our national champions while China has been nurturing its own,” laments Michael Pillsbury, who helped craft Donald Trump’s hawkish China policy. Siemens and Alstom cited the threat from CRRC, a Chinese trainmaker, to defend the planned merger of their rail divisions, which the European Commission blocked because it would hurt competition in the EU. “Before the ink was dry [on the commission’s decision] CRRC was signing contracts [with European railways],” fumes a former Siemens executive. “Do you have the right [these days] to avoid picking winners?” asks a Brussels lobbyist.

“Markets are good at allocating resources efficiently on a narrow understanding of efficient...What delivers highest returns to an individual investor is not necessarily in the economic interest of a nation,” says Oren Cass of American Compass, a right-leaning think-tank in Washington. Like Ms Mazzucato, who leans left, Mr Cass blames the innovation drought on governments abandoning their role as midwife to technological breakthroughs, as they were for the internet and biotechnology.

| *Remembering Apollo*

In China, the answer to such concerns is simple: more state. Liu He, the vice-premier, has said that the country is moving into a new phase that prioritises social fairness and national security, not the growth-at-all-costs mentality of the past 30 years. Elsewhere, the model is often China. Some Western analysts point approvingly to its ability to set strategic missions and co-ordinate the public and private sectors. There is a sense that China has learned what America has forgotten since the Apollo programme.

Since the covid-19 pandemic, many countries have tried to emulate elements of the Chinese playbook. In Japan 57 Japanese companies will get around \$500m in subsidies to invest at home. The country’s newish prime minister, Kishida Fumio, has created the job of economic-security minister, with a mandate to intervene in matters ranging from cybersecurity to chipmaking.

The EU has doubled down on a consortium to make batteries, earmarked some €160bn (\$180bn) of its covid-19 recovery fund for digital innovations, especially chips, and, inspired by Ms Mazzucato, launched five “missions” (they include such diverse goals as to improve the lives of more than 3m people at risk of cancer, restore “our ocean and waters” and achieve 100 climate-neutral smart cities by 2030). Thierry Breton, the single-market commissioner and a former French finance minister, is dirigiste at heart. In October President Emmanuel Macron unveiled the “France 2030”

programme, which will spend €30bn over five years on ten areas from the specific (small nuclear reactors, medicines) to the vague (cultural and creative content production).

In the same month Rishi Sunak, Britain's Conservative chancellor, proposed to funnel billions to the private sector. Tax relief for research and development, nearly half of which firms claimed for work done outside Britain in 2019, will be "refocus[ed]...towards innovation in the UK". One former senior official describes Boris Johnson's Tory party as "neo-Gaullist, if anything". One bank boss thinks "Britain is closest to Chinese thinking."

In Washington the words "industrial policy", once taboo lest the speaker seem a European socialist, reverberate in the White House, Congress, think-tanks and among K Street lobbyists. In one of his first acts as president, Joe Biden issued an executive order instructing government agencies to review supply chains, stretched to breaking point by the pandemic, to make them more "resilient"—which is to say more American. His signature \$2trn Build Back Better climate and social-spending bill, which passed the House of Representatives only to be blocked in the Senate by the opposition of Joe Manchin, a Democratic senator from West Virginia, was peppered with business incentives.

You might expect Republicans, historically sceptical of government, to recoil. In the case of Build Back Better, they have done. Yet elsewhere a reinvigoration of American industry is one of the few areas where Democrats and Republicans agree. When a \$25bn handout for semiconductor firms to make more advanced chips in America came up for a vote in the Senate in July 2020, 96 of the chamber's 100 members voted in favour.

The chip provision has since grown into \$52bn and been folded into the \$250bn Innovation and Competition Act, which includes \$80bn for

research on artificial intelligence (AI), robotics and biotechnology, \$23bn on space exploration and \$10bn for tech hubs outside Silicon Valley. The Senate approved it by 68 votes to 32—a huge level of support by today’s standards (the House will now pick it up). Conservative senators like Josh Hawley, Marco Rubio, Tom Cotton and Ted Cruz talk of a manufacturing renaissance. “The right of centre is learning a new vocabulary,” observes Mr Cass. It sounds remarkably, well, French.

Western leaders justify this revived industrial policy in two ways. One is to do with preserving countries’ rightful place in the global pecking order. The second is about domestic economic development. Politicians often trot out both at once. Presenting his “France 2030” vision, Mr Macron spoke of “a fight that is both civilisational and a value creator”. No speech by Mr Johnson seems complete without a nod to “global Britain” or “levelling up”, a nebulous idea to improve the lot of new Tory voters in the Midlands and north. After Mr Biden signed the \$1.2trn infrastructure bill, studded with goodies for American business, Nancy Pelosi, the House speaker, said: “These investments in working families are critical to delivering economic growth at home while ensuring our ability to outcompete China now and in the years ahead.”

On national-defence grounds, a dose of self-reliance may make sense. Advanced microchips are as critical to today’s warfighting as missiles. A large chunk of the world’s cutting-edge chips are manufactured in Taiwan, which is both an American ally (which troubles Beijing) and claimed by China (which worries Washington). Adversaries understandably covet at least some independent chipmaking capacity, just in case.

Like all insurance, this is expensive. For a narrow selection of critical resources the price is worth paying. But politicians tend to inflate the word “strategic” to cover cases where it is not. Mr Rubio thinks sugar counts. Mr Macron apparently believes cinema does.

The costs rise because, as a British business grandee notes, “Everyone has the same list of sexy stuff.” Peruse government plans and most feature AI, biotech, clean energy, semiconductors and quantum computing. “It is not efficient for everyone to have a wind industry,” jokes Jason Furman, Barack Obama’s former chief economist, now at Harvard. In the short run extra demand risks bidding up the cost of inputs. In the long term it could mean a supply glut. The “industrial-policy arms race” may turbocharge the boom-and-bust cycles that characterise capital-intensive industries, notably chipmaking, warns Scott Kennedy of the Centre for Strategic and International Studies, a think-tank.

Some public money will also bankroll projects that the private sector would have developed on its own. Carmakers already prefer to make or procure bulky electric-car batteries near their factories, given how costly they are to ship. Technology firms have every reason to keep on perfecting AI because of its moneymaking potential.

China also shows that, as ever, much government cash can simply go down the drain. Some of its most innovative companies, including tech giants such as Alibaba and Tencent, have thrived at arm’s length from the state. Where the government has been actively involved, by contrast, the results look “varied and often unimpressive”, says Felix Oberholzer-Gee of Harvard Business School. The Chinese state has poured more than \$70bn into developing a rival to Boeing and Airbus with only limited success so far. Its biggest chipmaker, SMIC, was years behind the cutting edge even before Mr Trump’s sanctions deprived it of the latest chipmaking technology. And for all the Western handwringing over superior Chinese AI skills, these are mostly confined to unsophisticated tasks such as image labelling.

To be fair, academic proponents of the “venture-capitalist state”, like Ms Mazzucato and Mr Cass, are not fans of wasteful pork-barrel spending. They would like governments to back genuinely out-there ideas ignored by the

private sector, to set clear performance yardsticks and, critically, to be as ruthless as Silicon Valley at pulling the plug on failures. “You don’t need the ability to pick winners. You need the ability to let losers go,” says Dani Rodrik of Harvard, whose paper in 2004, “Industrial Policy for the 21st Century”, helped to seed new interest in the notion.

In practice, political incentives make governments, even China’s, worse at withdrawing support from duds than at identifying the next big thing. The Apollo model may be ill-suited to today’s complex challenges. Ms Mazzucato herself concedes that sending the man to the Moon was primarily a technical problem. Decarbonising Europe or vaccinating America involve an awful lot of tricky social engineering, as well as the physical kind.

Even some proponents of industrial policy doubt that the goals of boosting innovation and creating lots of well-paying jobs complement each other. If your goal is to cure cancer, you should invest in an existing biotech hub like Boston not a provincial town, says Mr Furman. And if it is to shore up the middle class, there are better ways to do it. “Technological change means that promotion of manufacturing is not going to do much for employment and inclusion,” says Mr Rodrik. He points to South Korea and Japan, where the share of manufacturing in GDP has risen at constant prices even as the share of manufacturing employment has kept falling, owing to automation. According to Ro Khanna, a Democratic congressman, the goals of fostering inclusion and jobs on one hand and national assets on the other “won’t be harmoniously aligned. That would be wishful thinking.” That he helped to craft the innovation-hub provisions in the \$250bn Senate innovation bill shows how politically attractive bundling them together is.

| *Winners and losers*

Companies are following the industrial-policy debate with a mix of zeal

and alarm. Less favoured firms or sectors grumble about being left out. A Brussels lobbyist criticises the EU battery consortium for “going much too radically in one direction” by focusing on lithium-ion technology, which is useful in some areas like passenger electric cars but less so in others. What about fuel cells, which may be better suited for heavy transport, or more efficient combustion engines as a bridge to a cleaner future, he asks. Britain’s creative industry looks longingly at Mr Macron’s pampering of French filmmakers. Some British airlines, which unlike their European peers were left out of pandemic relief support, feel “buggered”, says the business grandee.

Neil Bradley, at the US Chamber of Commerce, has no qualms about industrial policy that backs basic research or improves security and diversity of supply chains. But he is wary of “using government policy to manipulate the market”. “You can see hints of it in discussions of onshoring and reshoring,” he says. “The middle-class foreign-policy or worker-centric trade policy is basically protectionism,” says Hank Paulson, a former Goldman Sachs boss and treasury secretary under George W. Bush and founder of the Paulson Institute for Sino-American business relations. Both Republicans and Democrats “want to tell business what to do”, he sighs.

Companies which may benefit from government largesse are naturally more enthusiastic. Pat Gelsinger, boss of Intel, welcomed the news of impending semiconductor splurges with congratulatory tweets. The American giant is one of the first in line to receive a handout at home as well as in Europe, which lacks advanced chipmakers of its own. The 500 or so corporate members of the European battery consortium are hardly complaining about too much EU cash.

Even beneficiaries air gripes, however. A well-connected lobbyist in Washington reports that carmaking clients are furious about the union-

labour and local-content requirements for EV subsidies in the infrastructure package. Wind-power developers have lashed out at “Buy American” provisions attached to tax credits. Elon Musk, boss of Tesla, has also panned Mr Biden’s EV subsidies. An American chip entrepreneur, T.J. Rodgers, has argued against subsidies to his sector, noting that in 1987 the Sematech consortium began spending \$500m in government funds “that did zero for the industry”. “‘Free government money’ induces horribly inefficient spending and undeserved payouts to executives and shareholders,” he writes. Mr Gelsinger dislikes the flipside of being part of a sensitive industry—being barred by his government from selling products to China. “If Chinese customers want more chips from the US, we should say yes,” he suggests.

A consultant close to Mr Johnson reports that some British bosses are wondering how becoming wards of one government will go down in other capitals. Becoming too cosy with the state can leave you nobbled elsewhere. More chief executives face this dilemma today than in the heyday of industrial policy 40 years ago, when companies were less multinational and multinationals less global. The ultimate choice will differ from boardroom to boardroom. But one consultant has a warning to those business leaders who lap up the largesse: “Be careful what you wish for.” ■



新产业政策

产业政策在许多国家复兴

一种先前声名扫地的方法找到了新的信徒【专题《新干预主义》系列之一】

在1970年代后期的滞胀过后，随着国家经济和国际贸易的自由化，政府越来越多地决定允许企业遵循商业逻辑行事。跨国公司在最合理的地方开店，分配资源、外包劳动力并让工厂自动化，以求尽量降低成本、提升利润。本轮改革使数以亿计的人摆脱了贫困，同时为股东带来了丰厚的回报。

但“国家插手越少越好”的共识正在瓦解。2008年的崩盘、中产阶级工作岗位流失给外国人或机器人以及气候危机使许多人认为市场是不可信的。伦敦大学学院的玛丽安娜·马祖卡托（Mariana Mazzucato）等经济学家认为，企业正在失去创新能力，这会影响未来的繁荣。在中国和西方的分歧中，双方的国家安全鹰派都担心依赖对手获取从半导体到药品的关键资源的风险。西方老板抱怨来自中国受政府支持的庞然大物的“不公平竞争”。

“我们一直在摧毁我们的国家领军企业，而中国一直在培养他们的。”帮助制定了特朗普强硬对华政策的迈克尔·皮尔斯伯里（Michael Pillsbury）感叹道。西门子和阿尔斯通以中国火车制造商中国中车的威胁来为其铁路部门的合并计划辩护，而欧盟委员会阻止了合并，因为这会损害欧盟内的竞争。“[委员会的决定] 墨迹未干，中国中车就在[与欧洲的铁路公司] 签订合同，”一位西门子前高管怒斥道。“[这年头] 你有权利避免挑选赢家吗？”一位布鲁塞尔的说客问道。

“市场善于根据对效率的狭隘理解来高效地分配资源.....为个人投资者带来最高回报的东西不一定符合一个国家的经济利益。”华盛顿的右倾智囊团美国指南针（American Compass）的奥伦·卡斯（Oren Cass）说。与左倾的马祖卡托一样，卡斯将创新的枯竭归咎于政府放弃了作为技术突破助产士的角色，不再像当年为互联网和生物技术所做的那样。

| 怀念阿波罗

在中国，这种担忧的答案很简单：扩大国家的角色。副总理刘鹤说过，中国正在进入一个优先考虑社会公平和国家安全的新阶段，而不是过去30年不惜一切代价实现增长的心态。在其他地方，榜样往往是中国。一些西方分析家赞许地指出，中国有能力设定战略使命并协调公共和私营部门。人们感到，中国学到了美国在阿波罗计划之后忘记了的东西。

自新冠疫情以来，许多国家都试图抄中国的作业。在日本，57家日本公司将获得约5亿美元的补贴用于在国内投资。新任首相岸田文雄新创了经济安全部长一职，其任务是干预从网络安全到芯片制造的各种事务。

欧盟已加倍投资一个制造电池的财团，并从其新冠复苏基金中拨出约1600亿欧元（1800亿美元）用于数字创新，尤其是芯片。它还在马祖卡托的启发下启动了五项“任务”（其目标非常多元化，例如改善300多万有患癌风险的人群的生活，恢复“我们的海洋和水域”，到2030年实现100个气候中和的智慧城市等）。欧洲单一市场专员、前法国财政部长蒂埃里·布雷顿（Thierry Breton）本质上是个干预主义者。去年10月，马克龙总统公布了“法国2030”计划，将在五年内花费300亿欧元，投资于从具体（小型核反应堆、药品）到相对模糊（文化和创意内容制作）的十个领域。

同月，英国保守党大臣里希·苏纳克（Rishi Sunak）提议向私营部门注入数十亿美元。研发税收减免（2019年有近一半被公司用在英国境外完成的工作领走了）将“重新聚焦于.....英国的创新”。一位前高级官员将鲍里斯·约翰逊的保守党描述为“新戴高乐主义者，如果非要比的话”。一位银行老板认为“英国是最接近中国式思维的一个”。

在华盛顿，“产业政策”一度是个禁忌词，以免演讲者看起来像个欧洲社会主义者，但现在却在白宫、国会、智囊团和K街说客中回荡。拜登在担任总统后首先做的事之一就是发布行政命令，指示政府机构审查因疫情而濒临崩溃的供应链，以使其更具“韧性”——也就是说更美国化。他标志性的2万亿美元“重建更好未来”气候和社会支出法案充满了商业激励措施。法案在众议院获得通过，在参议院却遭到来自西弗吉尼亚州的民主党参议员乔

- 曼钦（Joe Manchin）的阻击。

你可能会料想，历来对政府持怀疑态度的共和党人会出手抵制。在“重建更好未来”法案上确实如此。然而，在其他时候，重振美国工业是少数几个两党有共识的领域之一。2020年7月，当向半导体公司拨款250亿美元用于在美国制造更先进芯片的提案提交参议院投票时，100名参议员中有96人投了赞成票。

此后，芯片拨款已增至520亿美元，并被纳入2500亿美元的《创新与竞争法案》。该法案包括800亿美元用于人工智能、机器人和生物技术研究，230亿美元用于太空探索，100亿美元用于硅谷外的其他技术中心。参议院以68票对32票批准了它——按照今天的标准，这个支持率非常高了（现在送到众议院了）。乔什·霍利（Josh Hawley）、马可·卢比奥（Marco Rubio）、汤姆·科顿（Tom Cotton）和特德·克鲁兹（Ted Cruz）等保守派参议员谈论着制造业的复兴。“右翼正在学习一套新语汇。”卡斯说。它们听起来非常.....法国。

西方领导人为重振产业政策找了两个理由。一是维护国家在全球排名中的合理地位。二是关乎国内经济发展。政客们经常同时提到这两点。在介绍他的“法国2030”愿景时，马克龙谈到了“一场既关乎文明又创造价值的斗争”。约翰逊在演讲时要是不提一句“全球化英国”或是“拉平”（一个改善英国中部和北部新保守党选民命运的模糊想法）似乎就不完整。在拜登签署了包含对美国商界大量扶持的1.2万亿美元的基础设施法案后，众议院议长南希·佩洛西表示：“这些对工薪家庭的投资至关重要，不仅是在实现国内经济增长方面，也在于确保我们有能力在现在和未来战胜中国。”

在国防方面，一定程度的自力更生可能是有道理的。先进的微芯片对于当今的战争而言和导弹一样重要。世界上很大一部分尖端芯片是在台湾制造的，美国罩着台湾（令北京感到不安），中国认为台湾是不可分割的一部分（令华盛顿感到担忧）。为了以防万一，对手方觊觎至少一些独立的芯片制造能力是可以理解的。

像所有保险一样，这很昂贵。对于少数关键资源，这个代价是值得的。但政客们倾向于夸大“战略”这个词来涵盖算不上关键的东西。卢比奥认为糖很重要。马克龙显然相信电影也是。

成本在上升是因为，正如一位英国商业大亨所说，“每个人认为诱人的东西都一样。”读一下政府计划，大部分都会提到人工智能、生物技术、清洁能源、半导体和量子计算。“每个国家都去拥有风能产业的效率不高，”奥巴马的前首席经济学家、现任职于哈佛大学的杰森·弗曼（Jason Furman）开玩笑说。在短期内，额外的需求有抬高投入成本的风险。从长远来看，这可能意味着供应过剩。智库战略与国际研究中心的斯科特·肯尼迪（Scott Kennedy）警告说，“产业政策军备竞赛”可能会加剧资本密集型行业的繁荣与萧条周期，尤其是芯片制造。

一些公共资金还将资助私营部门本会自行开发的项目。考虑到运输成本很高，汽车制造商已经更愿意在工厂附近制造或采购笨重的电动汽车电池。科技公司完全有理由继续完善人工智能，因为它有赚钱的潜力。

中国也展示了一点：与以往一样，许多政府资金可能会付诸东流。它的一些最具创新力的公司，包括阿里巴巴和腾讯等科技巨头，都在远离政府的地方蓬勃发展。哈佛商学院的费利克斯·奥伯霍尔泽-吉（Felix Oberholzer-Gee）说，相比之下，在政府积极参与的情况下，结果看起来“良莠不齐，而且往往平平无奇”。中国政府已投入超过700亿美元用于发展波音和空中客车的竞争对手，但迄今为止进展不大。其最大的芯片制造商中芯国际甚至在特朗普的制裁让其无法获得最新的芯片制造技术之前就已经落后了多年。尽管中国出色的人工智能技术让西方感到焦虑，但这些大多局限于简单的任务，例如图像标注。

说句公道话，“VC国家”的学术支持者，如马祖卡托和卡斯，并不支持浪费巨大的政治分肥支出。他们希望政府真正支持被私营部门忽视的想法，制定明确的绩效标准，并且至关重要，像硅谷那样无情淘汰失败的项目。“你不需要挑选赢家的能力。你需要让失败者离场的能力。”哈佛大学的丹尼·罗德里克（Dani Rodrik）说。他在2004年发表的论文《21世纪的

产业政策》帮助酝酿了对产业政策重燃的兴趣。

在实践中，政治诱因使得政府，甚至是中国政府，在撤出对哑弹的支持方面比找出下一个重大突破上的表现更糟糕。阿波罗模式可能不适合当今的复杂挑战。马祖卡托自己也承认，将人送上月球主要是一个技术问题。而使欧洲脱碳或给全美接种疫苗除了实体工程，还涉及大量棘手的社会工程。

甚至一些产业政策的支持者也怀疑，促进创新和创造大量高薪工作的目标并非相辅相成。如果你的目标是治愈癌症，你应该投资像波士顿这样的现有的生物技术中心，而不是偏远的小镇，弗曼说。如果是要支持中产阶级，还有更好的方法来做到这一点。“技术变革意味着促进制造业不会对就业和包容性有太大作用。”罗德里克说。他指出，以不变价格计算，韩国和日本的制造业占GDP的份额一直在上升，但同时由于自动化，制造业就业的份额一直在下降。根据民主党国会议员罗·卡纳（Ro Khanna）的说法，一面要促进包容和就业，一面要培育国家资产，这两个目标“并不会和谐一致。那只是一厢情愿”。他帮助制定了2500亿美元的参议院创新法案中的创新中心条款，从中可见将它们捆绑在一起具有多大的政治吸引力。

| 赢家和输家

关注产业政策辩论让公司喜忧参半。不太受青睐的公司或行业抱怨被排除在外。布鲁塞尔的一位说客批评欧盟电池联盟专注于锂离子技术，“在一个方向上过于激进”。锂离子技术在乘用电动汽车等某些领域很有用，但在其他领域就不那么有用了。他问道，可能更适合重型运输的燃料电池呢？或者充当通向更清洁未来的桥梁的更高效的内燃机呢？英国的创意产业艳羡地看着马克龙对法国电影人的娇宠。这位商业大亨说，一些英国航空公司没能享受欧洲同行的待遇，被排除在疫情救济支持之外，感觉“心好累”。

美国商会的尼尔·布拉德利（Neil Bradley）全心赞同那些支持基础研究或提高供应链安全性和多样性的产业政策。但他提防“利用政府政策操纵

市场”。“你可以在关于外包和回流的讨论中看到这种痕迹。”他说。“服务中产阶级的外交政策或以工人为中心的贸易政策基本上是保护主义。”高盛前老板、乔治·W·布什手下的财政部长、保尔森中美商业关系研究所创始人汉克·保尔森（Hank Paulson）说。他叹息道，共和党人和民主党人都“想告诉企业该做什么”。

那些可能从政府的慷慨中受益的公司自然反应更加热情。英特尔的老板帕特·盖辛格（Pat Gelsinger）对半导体投资狂潮即将到来的消息发表了祝贺推文。这家美国巨头是最早在自己国家和欧洲获得援助的公司之一，因为欧洲缺乏自己的先进芯片制造商。欧洲电池联盟的500多家成员企业不大会去抱怨欧盟给的钱太多了。

然而，即使是受益人也会有怨气。华盛顿一位人脉广泛的说客报告说，基础设施法案中电动汽车补贴要求的工会劳工和本地含量让他那些汽车制造商客户怒不可遏。风力发电开发商猛烈抨击税收抵免附带的“购买美国货”条款。特斯拉的老板伊隆·马斯克也批评了拜登的电动汽车补贴。美国芯片企业家T.J. 罗杰斯（T.J. Rodgers）反对对他的行业进行补贴，并指出1987年Sematech财团花了5亿美元的政府资金，却“对行业贡献为零”。“‘免费的政府资金’导致了极其低效的支出，以及对高管和股东不应有的付款。”他写道。盖尔辛格不喜欢的是成为敏感行业的另一面——被政府禁止向中国销售产品。“如果中国客户想要更多来自美国的芯片，我们应该答应。”他说。

一位与约翰逊关系密切的顾问报告说，一些英国老板想知道被一个政府监护后会如何被其他国家看待。与国家走得太近会让你在其他地方举步维艰。与40年前产业政策的鼎盛时期相比，如今面临这种困境的首席执行官更多，因为当时的跨国公司较少，那些公司的全球化程度也较低。最终的选择全看各家公司的董事会了。但一位顾问对那些欣然接受慷慨馈赠的商界领袖发出警告：“许愿需谨慎。” ■



Schumpeter

TikTok isn't silly. It's serious

It is disrupting America's social-media landscape

“WHEN YOU gaze into TikTok, TikTok gazes into you,” wrote Eugene Wei, a tech blogger, in 2020, explaining the almost clairvoyant nature of TikTok. What the algorithm sees as it gazes into your columnist, a neophyte user, is anyone's guess: a random feed delivers tips on how to design a ball gown, someone barking at a dog, Rod Stewart with a hankie on his head, and (pew!) Maya Angelou reciting “Phenomenal Woman”.

Schumpeter is quite clear, however, about what he sees in TikTok. It is not just the busty seductiveness of many of the clips that he cannot help noticing. It is the serious money changing hands. And the unmistakable thrill of creative destruction.

About time. Just five years after its birth, TikTok claims to have exceeded 1bn monthly users, despite a ban in India. On January 12th App Annie, a data gatherer, said TikTok caught up with Facebook in 2021 and overtook WhatsApp and Instagram in time users spent on it. Notwithstanding a judge's decision on January 11th to allow America's Federal Trade Commission to sue Meta, the social-media trio's parent company, on antitrust grounds, TikTok's success appears to mock the argument that Facebook is impregnable.

TikTok derives its magic from its algorithm and the data on which it is trained. Unlike Facebook's rolling feed, TikTok's simple, one-video interface means that the app always knows exactly what a user is watching. Clips are short, so viewers see a lot of them, generating plenty of information. This, combined with few friends and family clogging up the feed, allows the algorithm to match users with content creators that actually entertain

them. And because videos are mostly shot on a smartphone, anyone can make them. Barriers to entry are low. Virality is high.

A big question remains. Can TikTok win business as well as it woos eyeballs? Its provenance has long suggested it can. It is born out of ByteDance, a privately held Chinese powerhouse that some think generated more than \$40bn in revenues in 2021. Its sister app, Douyin, has thrived in China's hyper-competitive social-media market, which makes Silicon Valley look staid by comparison. That gives TikTok hands-on commercial experience to draw on.

So far its revenues, though growing fast, are reportedly low (it discloses no financial information). That is unsurprising. Donald Trump's abortive attempt in 2020 to ban it on national-security grounds scared away advertisers. The ensuing drama—a thwarted sale, management upheaval and uncertainty over its relationship with ByteDance—caused yet more disarray. But these hurdles now appear to be behind it. In the absence of further geopolitical turmoil, TikTok could shake up the business model of social media in America, not just the user experience.

There are several ways it could do so. Start with advertising. Google and Facebook pioneered the pay-per-click approach. TikTok is transforming it further, inviting brands to work with creators to make potentially viral content, such as skateboarders swigging Ocean Spray juice to the sound of Fleetwood Mac. Sometimes a brand's presence might only be visible via a hashtag.

Second, e-commerce. Like other American social-media platforms, TikTok now enables viewers to buy goods directly by tapping a shopping tab on a video. It has teamed up with Shopify, an e-commerce platform, to bring more merchants to the site. So-called social commerce—including via live streaming—is far bigger in China than in America. Jeremy Yang of Harvard

Business School says TikTok may build on Douyin's experience in this field to bolster its online-shopping business.

Third, the creator economy. It is not just that, according to Forbes magazine, TikTok's seven highest-paid stars earned a total of \$55.5m from work on and off the platform last year, triple the sum it counted in 2020. TikTok has also recently introduced ways for users to provide gifts and tips to favoured creators, boosting the incentive to produce fresh material and providing fees to TikTok. Such practices first took off in China.

None of these innovations will amount to much if TikTok has another near-death experience. That is why it appears to be putting a final piece of its commercial strategy into place: balancing the demands of America and China. It has appointed Shou Zi Chew, a Singaporean of Chinese ethnicity, as CEO. He is based in the city-state, which serves as neutral territory. He is comfortable on both sides of the Sino-American divide, having been educated in the West and served as chief financial officer of ByteDance and Xiaomi, a Chinese smartphone-maker. It is still an open question whether he can—or even should—further disentangle TikTok from ByteDance to curb the perception that China could make nefarious use of TikTok's data. To do so may help geopolitically. But cutting TikTok off from an army of Chinese software engineers could also jeopardise its mind-reading brilliance.

TikTok faces plenty of other challenges. It needs to invest heavily in content moderation to ensure toxic videos are removed before they go viral. Addiction is a palpable concern, not just as a meme—#tiktokaddict has more than 500m views. The app faces probes about data privacy, particularly of under-age users. Regulatory risk will rise as TikTok becomes more prominent.

One thing TikTok need not fear is being crushed by the big beasts of Silicon

Valley (at least without help from Uncle Sam). Instagram has sought to mirror TikTok with “Reels”, and YouTube, owned by Google’s parent company, Alphabet, has introduced “Shorts”. Neither has damaged TikTok’s popularity.

| *#LessonforChina*

That is a good thing. TikTok is on the vanguard of ideas pioneered in China’s video-mad social-media landscape that have taken years to permeate America. At a time when the Chinese Communist Party is arbitrarily cracking down on the consumer-tech industry it is especially gratifying to witness Chinese free enterprise and ingenuity grab the world’s attention. ■



熊彼特

TikTok可不傻，是个狠角色

它正在颠覆美国的社交媒体格局

“当你凝视TikTok时，TikTok也在凝视你。”科技博主尤金·魏（Eugene Wei）在2020年如此形容TikTok那近乎能透视人心的洞察力。当算法凝视着刚开始玩TikTok的笔者时，还真说不好它看到了什么：随机推送的有舞会礼服设计妙招、某人对着一只狗学狗叫、头上顶着块手帕的洛德·斯图尔特（Rod Stewart）。还好，总算来了马娅·安杰卢（Maya Angelou）朗诵《了不起的女人》（Phenomenal Woman）。

然而，笔者很清楚自己从TikTok中看到了什么。不单单是许多展示傲人身材、让人忍不住看两眼的短视频，还有大笔的资金交易，以及创造性破坏带来的确凿无疑的兴奋感。

也该是时候了。TikTok面世仅五年，据称月用户数已超过10亿（即便遭印度政府封禁）。1月12日，数据收集机构App Annie称，TikTok的用户使用时长在2021年赶上了Facebook，并且超越了WhatsApp和Instagram。尽管法官在1月11日同意美国联邦贸易委员会（FTC）对这三个社交平台的母公司Meta发起反垄断诉讼，但TikTok的成功赶超似乎在嘲弄Facebook地位牢不可破的说法。

TikTok的魔力源自它的算法及训练算法所用的数据。有别于Facebook的滚动信息流，TikTok一次只呈现一条视频的简单界面意味着它总能准确知悉用户正在看什么。视频很短，所以观众会看很多个，这就生成了很多信息。再加上没有家人朋友的信息塞满推送内容，算法就能把用户与他们真正感兴趣的内容创作者匹配起来。而由于视频大多是用智能手机拍摄的，任何人都可以自己拍一段。进入的门槛低，走红的几率高。

但仍有一大问题。在吸睛之余，TikTok是否也能吸金？它的出身早已表明这应该不在话下。TikTok的母公司是字节跳动，据估计这家中国私人科技

巨头在2021年收入超过400亿美元。TikTok的中国版“抖音”在中国社交媒体市场极其激烈的竞争环境（令硅谷也显得平淡如水）中大展拳脚。这为TikTok提供了可借鉴的第一手商业经验。

到目前为止，尽管增长迅速，但据称TikTok的营收并不高（它没有披露财务信息）。这并不令人惊讶。特朗普在2020年企图以国家安全为由封禁TikTok，虽未成功，但吓跑了广告主。随之而来的戏剧性事件（出售未果、管理层大换血、与字节跳动的关系不明确）令情况更为混乱。而现在这些阻碍似乎都已消除。只要没有更多地缘政治动荡的干扰，TikTok也许不止会颠覆用户体验，还能撼动美国社交媒体的商业模式。

它可能通过几个途径做到这一点。先看广告。谷歌和Facebook开创了“按点击付费”的在线广告模式。TikTok进一步变革它，邀请品牌与创作者一起制作可能爆红的内容，比如滑板运动员在摇滚乐队佛利伍麦克（Fleetwood Mac）的乐声中畅饮优鲜沛（Ocean Spray）果汁。有时可能只有一个话题标签显示有品牌参与。

第二个途径是电子商务。和美国其他社交媒体平台一样，TikTok的观众现在可以点击视频上的购物标签直接购买商品。TikTok已联手电子商务平台Shopify，引入更多商家。“社交商务”（包括通过流媒体直播卖货）目前在中国的规模远大于在美国。哈佛商学院的杰里米·杨（Jeremy Yang）指出，TikTok可能会利用抖音在该领域的经验来发展其线上购物业务。

第三是内容创作者经济。据《福布斯》杂志报道，TikTok上收入最高的七名网红去年靠平台内外的的工作共赚得5550万美元，是2020年统计数字的三倍。不止如此，TikTok近来还推出新功能，方便用户给心仪的创作者打赏礼物和小费，这能刺激创作者制作新鲜内容，还能给TikTok带来抽成。这种做法首先兴起于中国。

如果TikTok再遭遇一回濒临绝境的体验，那么上述创新无一能帮到多少。所以TikTok似乎正着力补上自己商业战略的最后一块拼图：平衡中美两国的要求。它已任命华裔新加坡人周受资为CEO，他就在这个保持中立的城

邦国家工作。周受资在西方接受教育，又曾担任字节跳动和中国智能手机制造商小米公司的首席财务官，因而能在中美之间游刃有余。尚未可知的一点是他能否（甚至应否）让TikTok进一步脱离字节跳动，以抑制认为中国可能恶意使用TikTok数据的看法。这么做在地缘政治方面也许有用，但让TikTok与中国的软件工程师大军一刀两断也可能危及它那高明的“读心术”。

TikTok还面临很多其他挑战。它需要在内容审核方面大量投资以确保不良视频在广泛传播前就被删除。成瘾性也是个明摆着的问题，而不仅仅是个网络梗——带#tiktokaddict标签的视频浏览量超过五亿。这款应用还面临有关数据隐私的调查，尤其是未成年用户的数据。随着TikTok风头日盛，监管风险也将上升。

TikTok倒是无需担心会被硅谷的巨头碾压（至少在美国政府不插手打压的情况下）。Instagram推出了Reels试图模仿TikTok，谷歌母公司Alphabet旗下的YouTube推出了类似的Shorts，但两者都无损TikTok的热度。

| #留给中国的经验

这是好事。TikTok是创意理念的先锋，这些理念最先在短视频风行的中国社交媒体领域兴起，多年后才渗透到美国市场。在中国共产党恣意打压消费科技行业之际，能看到中国的自由企业和独创性吸引世界关注，这尤为可喜。■



The Economist Film

Is the era of low inflation over? Part 2

For central banks in emerging markets, sitting tight isn't always the best option.



经济学人视频

低通胀时代结束了吗？（下）

对新兴市场央行而言，静观其变并不总是最佳选择。



Bartleby

The rise of performative work

It's not what you do. It's how ostentatiously you do it

IN AN EPISODE of “Seinfeld”, a vintage TV sitcom, the character of George Costanza reveals the secret of pretending to work: act irritated. He shakes his head, frowns and sighs to demonstrate the technique. “When you look annoyed all the time, people think that you’re busy.” In comments posted below this clip on YouTube, visitors report with delight that the tactic really does work and offer a few tips of their own: walk around the office carrying manila envelopes, advises one.

Before the pandemic turned everyone into remote employees, managers worried that working from home would be a paradise for slackers like George. People would be out of sight and out of mind: starting late, clocking off early and doing nothing in between. The reality of remote working has turned out to be different. Days have become longer and employees are demonstratively visible. Work has become more performative.

The simple act of logging on is now public. Green dots by your name on messaging channels are the virtual equivalents of jackets left on chairs and monitors turned on. Calendars are now frequently shared: empty ones look lazy; full ones appear virtuous.

Communication is more likely to happen on open messaging channels, where everyone can see who is contributing and who is not. Emails can be performative, too—scheduled for the early morning or the weekend, or the early morning on the weekend, to convey Stakhanovite effort. Repeated noises like Slack’s knock-brush provide a soundtrack of busyness.

Meetings, the office’s answer to the theatre, have proliferated. They are

harder to avoid now that invitations must be responded to and diaries are public. Even if you don't say anything, cameras make meetings into a miming performance: an attentive expression and occasional nodding now count as a form of work. The chat function is a new way to project yourself. Satya Nadella, the boss of Microsoft, says that comments in chat help him to meet colleagues he would not otherwise hear from. Maybe so, but that is an irresistible incentive to pose questions that do not need answering and offer observations that are not worth making.

Shared documents and messaging channels are also playgrounds of performativity. Colleagues can leave public comments in documents, and in the process notify their authors that something approximating work has been done. They can start new channels and invite anyone in; when no one uses them, they can archive them again and appear efficient. By assigning tasks to people or tagging them in a conversation, they can cast long shadows of faux-industriousness. It is telling that one recent research study found that members of high-performing teams are more likely to speak to each other on the phone, the very opposite of public communication.

Performative celebration is another hallmark of the pandemic. Once one person has reacted to a message with a clapping emoji, others are likely to join in until a virtual ovation is under way. At least emojis are fun. The arrival of a round-robin email announcing a promotion is as welcome as a rifle shot in an avalanche zone. Someone responds with congratulations, and then another recipient adds their own well wishes. As more people pile in, pressure builds on the non-responders to reply as well. Within minutes colleagues are telling someone they have never met in person how richly they deserve their new job.

Theatre has always been an important part of the workplace. Open communication is a prerequisite of successful remote working. But the

prevalence of performative work is bad news—not just for the George Costanzas of the world, who can no longer truly tune out, but also for employees who have to catch up on actual tasks once the show is over. By extension it is also bad for productivity. Why, then, does it persist?

One answer lies in the natural desire of employees to demonstrate how hard they are working, like bowerbirds with a keyboard. Another lies in managers' need to see what everyone is up to. And a third is hinted at in recent research, from academics at two French business schools, which found that white-collar professionals are drawn to a level of “optimal busyness”, which neither overwhelms them nor leaves them with much time to think. Rushing from meeting to meeting, triaging emails and hitting a succession of small deadlines can deliver a buzz, even if nothing much is actually being achieved. The performance is what counts. ■



巴托比

表演式工作流行

做什么不重要。做得招摇才重要

在经典情景喜剧《宋飞正传》（Seinfeld）的某一集里，乔治·科斯坦萨（George Costanza）这个角色揭示了摸鱼的诀窍：表现得很恼火。他通过摇头、皱眉、叹气来展示这一技巧。“如果你看起来总是很恼怒，大家就会觉得你很忙。”YouTube上这段视频下方的评论中，访客们兴高采烈地表示这一招的确奏效，他们也贡献了一些自己的小妙招，比如有人建议拿着牛皮纸文件袋在办公室里走来走去。

在新冠疫情让所有人都变成远程员工之前，主管们曾担心居家工作会成为乔治这种懒虫的天堂。所谓天高皇帝远：员工晚开工，早下班，中间什么也没做。现实已经证明远程工作并非如此。工作时间变长了，员工的展示性状态更容易被看到。工作变得更具表演性质。

简单的登录动作现在公开可见。各种短消息频道上，名字旁边的绿点就相当于办公室中搭在椅背上的外套和打开的显示器。日历现在经常是共享的：空荡荡的看起来就很懒散；满当当的看着就很勤奋。

交流更可能在开放的短消息频道上进行，上面的每个人都能看见谁在积极参与而谁无所作为。电子邮件也可以让人一展演技——发送时间可以放在清晨或周末，或周末的清晨，从而展现斯达汉诺夫式的劳模精神。重复的声音，比如Slack里“哒哒哒”的通知音效，给这出忙忙叨叨的戏码提供了配乐。

会议本就是办公室里的表演舞台，现在它也激增了。想躲掉会议没那么容易了，因为邀请必须要回应，而且日志是公开的。即使你什么都不说，摄像头也能把开会变成一场哑剧表演：专注的表情加上偶尔点头现在也算是一项工作了。聊天功能成了一种展示自己的新方式。微软的老板萨蒂亚·纳德拉（Satya Nadella）说，聊天中的评论让他认识了原本不会有联系的

同事。也许的确如此，但这也促使人们不由自主地提出不需要回答的问题，说出不值得发表的意见。

共享文档和短消息频道也是表演的广场。同事们可以在文档中留下公开评论，算是告知文档作者自己已经做了些差不多可以算作工作的事情。他们可以开启新频道，邀请任何人加入；如果没人使用这些频道，他们就将其再次归档，显得自己很高效。他们给人分配任务，或是在对话里标记他人，结果就是他们的假装勤勉可能影响深远。近期的一项研究很能说明问题：该研究发现，高绩效团队的成员更可能用一对一打电话的方式交流，与公开交流这种方式截然相反。

表演式庆祝是疫情的另一道风景线。一旦有人用一个鼓掌的表情回复某条信息，其他人很可能也会加入进来，直到一场虚拟欢庆热烈上演。表情符号至少还很好玩。一封宣布有人升职的群发邮件就像在雪崩区鸣一枪那般叫人糟心。某个人回复道贺，另一个收件人又加上自己的祝福。随着越来越多的人涌入，原本没回应的人开始在压力之下回复。几分钟之内，同事们就开始对从未见过面的人说他们得到这个新职位是多么理所应当。

舞台一直是职场的重要组成部分。公开交流是远程工作成功的先决条件。但是，表演式工作大行其道是个坏消息——对乔治这样的人是如此，因为他们的戏没了喊卡的时候，对那些在演出结束后还要赶正经工作的员工亦然。更进一步来说，它也不利于生产率。那么，为什么它一直存在呢？

答案之一是员工的天性，他们像配了副键盘的园丁鸟一样，想要展示自己工作有多努力。另一个原因是管理者需要了解每个人都在忙什么。而从法国两所商学院的学者近期的一项研究中可以隐约窥见第三个原因。该研究发现，白领专业人士被“最佳忙碌”水平所吸引，这样的忙碌既不会让他们疲于奔命，也不会让他们有太多时间思考。从一个会议赶赴另一个会议，分类处理掉各种邮件，按一系列截止日期完成不那么紧要的任务，如此种种给人一种兴奋的成就感，即便实际上并没有多少成果。表演本身才是重要的。■



Direct to market

The rise of personalised stock indices

Direct-indexed accounts combine the benefits of customisation with those of passive investing

IN 2001 ANDREW LO, a professor at the Massachusetts Institute of Technology, predicted that technological advances would one day allow investors to create their own personal indices designed to meet their financial aims, risk preferences and tax considerations. Such an idea “may well be science fiction today”, Mr Lo wrote, but “it is only a matter of time.” More than 20 years later, that time may have come.

A revolution in passive investing that began in the 1970s led to the introduction of funds that track the performance of an index, such as the S&P 500, affording investors diversification at a low cost. Now a growing number of American fund managers and brokers are offering retail clients more personalised products that combine the benefits of passive investing with greater customisation. Direct-indexed accounts, as such products are known, promise to track the performance of a benchmark index. But unlike off-the-shelf mutual funds or exchange-traded funds (ETFs), which are pooled investment vehicles overseen by portfolio managers, investors in direct-indexed accounts own the underlying securities, and can tailor their portfolios to suit their needs.

The idea is not new. “Separately managed accounts”, custom portfolios of securities managed by professional investors, have been around since the 1970s. But such products have historically been available only to institutional investors and “ultra-high-net-worth” clients with millions of dollars to invest. Today direct-indexed accounts are within reach of the “mass affluent”, with liquid assets in the hundreds of thousands. “It’s what institutions have been doing for years,” explains Martin Small, head of the

US wealth-advisory business at BlackRock, an asset manager. “But with technology and scale and more automation, we can deliver it in smaller account sizes.”

Analysts point to three forces behind the trend. The first is advances in technology, including sophisticated algorithms and the computing power needed to continuously analyse and execute trades across hundreds of thousands of portfolios simultaneously. The second is the rise of zero-commission trading, which dramatically lowers costs. The third is the emergence of fractional-share trading, which allows investors to buy securities in bite-sized pieces, making it easier to build small diversified portfolios. Companies like Amazon, a single share of which costs more than \$3,000, can be included without breaking the bank.

Direct indexing is still a small part of the asset-management industry. According to Cerulli Associates, a research firm, roughly \$400bn was held in direct-indexed accounts by the end of June 2021. But Morgan Stanley, a bank, and Oliver Wyman, a consultancy, estimate that this figure could reach \$1.5trn by 2025, representing a growth rate of nearly 40% a year. Industry executives are bullish. “Personalised investing is coming at all of us like a freight train,” Walt Bettinger, the boss of Charles Schwab, a broker, said in October.

Such enthusiasm has fuelled a flurry of acquisitions. In October 2020 Morgan Stanley acquired Parametric Portfolio Associates, the biggest provider of direct-indexing services. A month later, BlackRock snapped up Aperio Group, another big provider. Several other big fund managers and brokers, including Charles Schwab, Vanguard and Franklin Templeton have made similar acquisitions. “Nobody wants to be left behind,” says Kevin Maeda, the chief investment officer of direct indexing at Natixis, a bank. “There’s a gold-rush mentality,” reckons Tom O’Shea of Cerulli.

Direct indexing has both benefits and costs. Its main selling point is its ability to lower tax bills. This is achieved primarily through a process called “tax-loss harvesting”, which involves selling and replacing losing stocks to offset gains in winning ones, thereby reducing capital gains subject to taxation. Although this technique can generate returns on the order of 1-1.5% per year, the benefits are close to nothing for individuals in lower tax brackets, or for investors who hold the bulk of their assets in retirement accounts, such as 401(k) plans, which defer taxes on investment gains until funds are withdrawn.

Another advantage of these accounts over conventional mutual funds or ETFs is customisation. For ethically minded punters, this could mean excluding fossil-fuel producers, tobacco companies or weapons-makers. The more customisation, the greater the likelihood that portfolio returns diverge from benchmark returns.

Direct-indexed accounts are often characterised as a disruptive threat to mutual funds and ETFs. In truth they are part of the same long-term trend. “This is really about the growth of indexing,” says Mr Small of BlackRock. “The growth of direct indexing and ETFs go together, they’re just different ways to gain index exposure,” he adds. Brian Langstraat of Parametric Portfolio Associates says that the primary driver of direct indexing is not lower costs or fractional shares but the decades-long shift towards passive investing. “The trends that are behind it are the same ones as five years ago,” he says, “and will be the same ones five years from now.”

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直达市场

私人定制股指兴起

直接指数化账户兼具定制化和被动投资之长

麻省理工学院教授罗闻全曾在2001年预测，终有一天技术进步会让投资者创建自己的个人指数，以满足其财务目标、风险偏好和税务考量。这样的想法“在今天可能很像是科幻小说”，罗闻全写道，但“这一天早晚会的到来”。20多年后，这一天可能已经来了。

始于1970年代的被动投资革命催生出追踪指数（如标普500）表现的基金，能以较低的成本为投资者实现分散投资。如今，越来越多的美国基金管理公司和券商正在为零售客户提供更加个性化的产品，在被动投资的优点上加入更多的定制化。此类产品被称为直接指数化账户（Direct-indexed accounts），追踪某个基准指数的表现。但它们有别于现成的共同基金或交易所交易基金（ETF）这些由基金经理管理的集合投资工具，由投资者直接持有标的证券，可以根据自身需求调整投资组合。

概念并不新鲜。“独立管理账户”自1970年代就出现了，它是由专业投资者管理的定制化证券投资组合。但这类产品历来只面向机构投资者，以及拥有数百万美元可投资资金的“超高净值”客户。如今，有几十万美元流动资产的“大众富裕阶层”也可以开设直接指数化账户。“机构客户多年来一直是这么操作的，”资产管理公司贝莱德（BlackRock）的美国财富投顾业务主管马丁·斯莫尔（Martin Small）解释道，“但随着技术、规模和自动化程度的提高，我们也可以为较小的账户提供这类服务。”

分析师指出，这一趋势背后有三股力量。首先是技术进步，包括先进的算法，以及同时为几十万份投资组合做连续分析和执行交易所需要的计算能力。其次是免佣金交易兴起，大大降低了成本。第三是零股交易的出现，让投资者可以零碎地购买不满一个成交单的证券，从而更容易建立小型的多样化投资组合。用不着倾尽所有，也可以把亚马逊这样每股价格超过3000美元的公司纳入投资组合。

直接指数化目前仍只占资产管理行业的很小一部分。研究公司Cerulli Associates的数据显示，截至2021年6月底，直接指数化账户持有的资金约为4000亿美元。但据摩根士丹利和奥纬咨询（Oliver Wyman）估计，该数字到2025年可能达到1.5万亿美元，意味着年增速接近40%。业内高管对此持乐观态度。“个性化投资正在到来，势不可挡。”券商嘉信理财（Charles Schwab）的老板沃尔特·贝廷格（Walt Bettinger）去年10月表示。

乐观情绪一时间催生了一系列收购。2020年10月，摩根士丹利收购了最大的直接指数化服务供应商“参数投资组合协会”（Parametric Portfolio Associates，以下简称Parametric）。一个月后，贝莱德拿下了另一家大型供应商Aperio集团。包括嘉信理财、先锋领航（Vanguard）和富兰克林邓普顿（Franklin Templeton）在内的其他几家大型基金管理公司和券商也完成了类似的收购。“谁也不想落在后面。”法国外贸银行（Natixis）的直接指数化投资总监凯文·前田（Kevin Maeda）说。“有一种淘金热的心态。”Cerulli的汤姆·奥谢（Tom O’shea）认为。

直接指数化有利也有弊。它的主要卖点是能够减少纳税。这主要是靠名为“投资损失节税”（tax-loss harvesting）的操作实现的：出售和替换亏损的股票，来抵消盈利股票的收益，从而减少应课税的资本利得。尽管这种方法带来的好处大约相当于1%到1.5%的年回报率，但对于处于低税率等级的个人益处微乎其微，对于大部分资产都放在401(k)之类退休账户的投资者也意义不大，因为这类退休计划在资金被提取前都对投资收益延迟征税。

与传统的共同基金或ETF相比，这类账户的另一个优势是定制化。对于注重道德的投资者来说，这或许意味着可以将化石燃料生产商、烟草公司或军火制造商排除在组合之外。定制化程度越高，投资组合回报偏离基准回报的可能性就越大。

常有人认为直接指数化账户对共同基金和ETF有颠覆性的威胁。事实上，它们是同一个长期趋势的一部分。“这实际上与指数化的不断发展有关。”贝莱德的斯莫尔表示。“直接指数化和ETF共同成长，它们只是获得指数敞

口的不同方式而已。”他补充道。Parametric的布莱恩·朗斯特拉特（Brian Langstraat）表示，直接指数化的主要驱动力不是成本降低或者零碎股票，而是数十年来向被动投资的转变。“现在的驱动趋势和五年前一样，”他说，“五年后也还会一样。”

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Stoppage time

For elite footballers, the effects of covid-19 linger for months

Long after infection, players play fewer minutes and complete fewer passes

“AFTER FIVE minutes of movement I had to stop because I was struggling to breathe,” explained Paulo Dybala in March 2020. It was a common experience of covid-19 relayed by a very uncommon man. Mr Dybala is a star forward for Juventus, a leading Italian football team, whose athleticism fetches more than \$10m a year.

Fortunately for Mr Dybala, the postponement of football matches until June 2020 left him enough time to recover. But for other players at the highest echelons of the sport, even three months may not have been long enough.

That is according to recent research by three economists—Kai Fischer and W. Benedikt Schmal of Heinrich Heine University as well as J. James Reade of the University of Reading. With some detective work, they were able to identify 90% of the 257 positive cases reported by the German Bundesliga and Italian Serie A through to July 2021 (the announcements are sometimes anonymised). They then combined this register with detailed data from Opta, a sports-data firm, on performance measures like minutes played, distance run and passes completed.

If relative performance between infected and uninfected players was stable before contracting covid, but declines after, this should indicate the lingering effects of the virus. Using this statistical methodology (called “difference-in-differences”), the authors detected a decline of 9% in minutes played. Passes completed fell by 6% and did not return to normal for months.

The Economist found a similar pattern when we replicated the analysis

using a more sophisticated player-value score (a composite of more than 40 on-field activities) provided by the Twenty First Group, a sports-intelligence consultancy. In the ten weeks after infection there was an average drop in score of 0.14 standard deviations (equivalent to the median player dropping to the 30th percentile). But after ten weeks these reverted to normal, suggesting that players may compensate for passing less and spending less time on the pitch.

The odds of recovery from covid are stacked in favour of footballers, who are young, fit and able to get world-class medical care. The incentives to recover fully are much greater than for the ordinary citizen. Research on long covid is still progressing. But the fact that it may linger even in the professional game is a worrying sign.

Source: “The long shadow of an infection: Covid-19 and performance at work”, by Kai Fischer, J. James Reade and W. Benedikt Schmal, working paper, 2021 ■



伤停补时

对精英足球运动员来说，新冠肺炎的影响持续数月

感染很久之后，球员上场时间仍比以前短，成功传球次数也更少

“才跑动了五分钟，我就喘不过气来，不得不停下来。”保罗·迪巴拉（Paulo Dybala）在2020年3月解释说。这是感染新冠肺炎后的寻常经历，讲述者却不是一个寻常的人。迪巴拉是意大利顶级球队尤文图斯的明星前锋，靠球技每年收入超过1000万美元。

对迪巴拉来说，幸运的是足球赛事推迟到了2020年6月，这让他有足够的时间恢复。但对于其他顶级足球运动员来说，三个月的恢复时间可能还是不够。

这是三位经济学家最近研究得出的结论，他们是海因里希·海涅大学（Heinrich Heine University）的凯·菲舍尔（Kai Fischer）和W·贝尼迪克特·施马尔（W. Benedikt Schmal）以及雷丁大学（University of Reading）的J·詹姆斯·里德（J. James Reade）。他们做了一番侦查工作，确定了截至2021年7月德甲和意甲报告的257例阳性病例中90%的球员姓名（这些检测结果有时是匿名发布的）。然后，他们将这个名单与来自体育数据公司Opta的上场时间、跑动距离和成功传球次数等详细表现数据结合起来分析。

如果受感染球员在感染新冠病毒之前的表现相对于未感染球员是稳定的，但在感染之后有所下降，应该就表明病毒还在持续影响着球员。使用这种统计方法（称为“双重差分”），三位作者发现，受感染球员上场时间下降了9%。成功传球次数下降了6%，并且过了几个月都没有恢复到正常状态。

本刊使用体育情报公司Twenty First Group提供的更复杂的球员价值评分（综合了40多项场上活动数据）来重复这项分析，发现了类似的模式。在感染后的十周内，受感染球员的评分平均下降了0.14个标准差（相当于处

于中位的球员下降到第30个百分位)。但十周后，评分恢复正常，表明他们可能从其他方面弥补了传球成功次数和上场时间的减少。

足球运动员年轻、健康、能享受世界级医疗护理，从新冠肺炎康复的几率很大。他们完全康复的动力也远大过普通民众。对新冠肺炎长期影响的研究仍在进行中。但即使是职业运动员也可能受到挥之不去的影响，这真是个令人担忧的迹象

资料来源：《一次感染的漫长阴影：新冠肺炎与工作表现》，凯·菲舍尔、J·詹姆斯·里德和W·贝尼迪克特·施马尔著，2021年工作论文■



Xenotransplantation

The science behind the first successful pig-to-human heart transplant

It may lead to a new approach to organ transplantation

ON JANUARY 7TH David Bennett became the first person to have a heart transplanted successfully into him from a pig. In press material issued three days after the operation, the University of Maryland confirmed Mr Bennett was doing well, and was capable of breathing on his own. While he continues to rely on artificial support to pump blood around his body, the team behind the surgery, led by Bartley Griffith, plan gradually to reduce its use.

This operation is a milestone for xenotransplantation—the transfer of organs from other species to human patients. It comes hot on the heels of another, in October, when a pig’s kidney was successfully attached for three days to a brain-dead patient in a hospital in New York. On that occasion, mere surgical success was the goal. But Dr Griffith’s team hope to save a life.

The operation itself received exceptional authorisation from America’s Food and Drug Administration under a provision which lets doctors use experimental treatments as a matter of last resort. Prior to it Mr Bennett was diagnosed with terminal heart disease, but was judged too ill to qualify for a human transplant. Having spent months in a hospital bed with no improvement to his condition, he gave his consent to the surgery.

The field’s recent flowering has long-established roots. For decades, researchers have attempted to tackle xenotransplantation’s fundamental problem. This is that the human body, when it recognises foreign tissue, has a tendency to turn against it. In the case of pigs, the most important marker of foreignness is a sugar molecule called galactose-alpha-1,3-galactose (alpha-Gal), which is found on the surfaces of their

cells. While this molecule does not exist in humans, antibodies to suppress it do. Consequently, no transplant from a pig with alpha-Gal would last more than a couple of minutes in a human body.

In 2003 pigs were produced with a genome modified so as to suppress the enzyme responsible for making alpha-Gal. This was a step in the right direction, but other barriers popped up in its place. As Frank Dor of Imperial College, London, who was involved in that original genome-modification project, observes, with each of these barriers requiring years of work to overcome, many researchers—and much research funding—abandoned the field.

One collaboration which survived was that between the University of Maryland and Revivicor, a regenerative-medicine company in Blacksburg, Virginia. It was Revivicor that provided the genetically modified pig for Friday's surgery. The animal in question had a genome modified in ten ways, to optimise the chances of success. Three genes had been removed to reduce the risk of a human antibody rejecting the donor organ. A fourth, a growth gene, had also been knocked out, to ensure the heart did not enlarge after transplantation. And six human genes had been added, to promote acceptance.

In addition to the usual risks surrounding any heart transplant, there are a number of areas of concern that Dr Griffith and his colleagues will be looking out for. One is any hitherto-unknown rejection mechanism. Another is the possibility that the organ may transfer porcine viruses to its new host. The pig in question was reared in a sterile environment to minimise the chance of that, but it remains a possibility.

Supporters of xenotransplantation think its potential to improve lives is huge. In America alone, over 100,000 people are waiting for transplants (though the vast majority need a kidney rather than a heart). In 2020 only a

third of the required number of organs became available.

In theory, pigs can be bred to provide humans with any solid organ, though some will be more complex than others. A large part of the heart's function is mechanical, but other organs have chemical jobs that will be harder to replicate. Moreover, even assuming these barriers can be overcome and successful surgical procedures developed, most researchers still acknowledge that scaling up xenotransplantation to meet the world's demand for organs may take decades. After this news, however, the chances that it will happen eventually have increased. ■



异种移植

首例猪心成功移植人体背后的科学

这可能导向一条器官移植的新路径

一月七日，大卫·班尼特（David Bennett）成为成功接受猪心脏移植的第一人。在手术三天后发布的新闻稿中，马里兰大学证实班尼特情况良好，能自主呼吸。虽然他仍依赖人工支持系统来辅助心脏泵血至全身，但由巴特利·格里菲斯（Bartley Griffith）率领的手术团队计划逐步减少人工支持。

这项手术是异种移植（即把其他物种的器官移植给人类患者）的一大里程碑。而就在不久前，也就是去年10月，纽约一家医院实施过另一次手术，成功将猪的肾脏移植到了一名脑死亡患者身上，维持了三天而未出现排异反应。当时的目标仅仅是成功完成移植手术。而这次格里菲斯的团队是要救回一条人命。

这次手术得到了美国食品和药物管理局（FDA）的特别批准，依据的规定是医生可以在穷尽所有治疗手段后诉诸实验性疗法。班尼特在此前被诊断为晚期心脏病患者，但病情太过严重而不适合接受人体心脏移植。在住院多月而病情不见好转后，班尼特同意进行这次手术。

这一领域近期的喜人成果源于长期积累。几十年来，研究人员一直试图解决异种移植的根本性难题，即人体在识别到外来组织时往往会产生排斥反应。在猪这个案例上，它最重要的异物标识是名为半乳糖- α -1,3-半乳糖（简称 α -Gal）的糖分子，存在于猪细胞的表面。人体没有这种分子，却有能抑制它的抗体。因此，带有 α -Gal的猪器官移植到人体内撑不过几分钟就会坏死。

2003年，科学家培育出了经基因改造（以抑制负责制造 α -Gal的酶）的猪。这是朝正确方向迈出的一步，但随即就冒出了其他障碍。伦敦帝国理工学院的弗兰克·多尔（Frank Dor）参与了最初的猪基因组改造项

目，他指出，每克服一个障碍都需要多年的研究，许多研究人员因而放弃了这个领域，大部分科研资金也转投他处。

马里兰大学和位于弗吉尼亚州布莱克斯堡（Blacksburg）的再生医学公司 Revivicor 之间的合作是坚持下来的项目之一。正是 Revivicor 为 1 月 7 日的移植手术提供了经基因改造的猪。为提高移植的成功率，研究人员对这头猪的基因组做了十处修改。为减少人类抗体对移植器官的排斥风险，有三个基因被敲除。还移除了一个生长基因，以确保猪心脏在移植后不会增生。另外还添加了六个人类基因，以提升对人体免疫系统的耐受性。

除了心脏移植的常见风险之外，格里菲斯和他的同事接下来还会尤其警惕另外几种风险。一是任何迄今未知的排斥机制。另一个是移植器官把猪身上的病毒转移给受移植者的可能性。为尽量降低这种可能性，手术所用的猪是在无菌环境中养殖的，但风险依然存在。

异种移植的支持者认为它在拯救生命方面潜力巨大。单单在美国就有超过十万人在等候移植（尽管绝大多数人急需的是肾脏而非心脏）。在 2020 年，器官供应量仅为所需数量的三分之一。

理论上，可以养殖猪来为人类提供任何固态器官，尽管有些器官要更复杂。心脏的很大一部分功能是机械性的，其他器官的化学机制会更难复制。而且，假设能够克服这些障碍并成功开发出手术程序，大多数研究人员还是承认，可能需要几十年才能把异种移植的规模扩展到足以满足全球的器官需求。但是，在最近的喜报传来后，这最终会实现的几率就提高了。■



Agricultural science in orbit

Outer space offers plant breeders some curious advantages

Radiation and microgravity may give rise to better crops

PLANTS GROWN in orbit, and thereby deprived of the comforting directional pull of Earth's gravity, typically struggle to distinguish up from down. This makes it harder for them to carry water and nutrients around themselves. It also fouls up their ability to draw carbon dioxide needed for photosynthesis from the air. The stress caused by all this seems to increase the level of genetic mutation induced by a given amount of radiation—of which there is much in space, in the form of cosmic rays and effluvia from the sun. And mutations are the lifeblood of plant breeders.

On Earth, breeders induce them by exposing plants and seeds to radioactive isotopes, X-rays and so on. Most are harmful. But some hit the jackpot, conferring properties like drought resistance, blight resistance or shorter stems, favoured by farmers, and sweeter flavours, brighter colours or thinner peel, favoured by consumers. Plucked from their progenitors by selective breeding and added to cultivars, such mutations are worth millions. Mutagenesis, then, is an important business.

And it is one that StarLab Oasis, a firm in Abu Dhabi that was spun out of a Texan enterprise called Nanoracks in 2021, reckons it may be able to perform better. As the firm's name hints, the plan is to do the job using the natural radiation of space. Its researchers intend to start sending payloads of seeds to the International Space Station (ISS) later this year. Once there, those seeds will be cultivated by astronauts on board the station and allowed to grow and breed.

Subsequent generations of seeds resulting from this breeding will be returned to Earth and germinated in StarLab Oasis's greenhouses. They will

then be subjected to ills including drought, pathogens, poor soil, excessive heat and voracious insects. Those which best endure these assaults will be bred from in their turn, in the hope that something valuable emerges.

A cut-down version of this approach, launching packets of seeds on satellites and returning them to Earth after a period of exposure to cosmic radiation, has had some success. China says it has conducted more than 30 such missions, and that these have yielded at least 200 improved crop varieties. StarLab Oasis's boss, Allen Herbert, believes, however, that his firm is the first private organisation set up to take this route and, in particular, actually to raise plants in space for the purpose.

Mutagenesis is not, moreover, the only facility offered by space which may be of interest to botanists. The stress responses themselves also yield useful information.

Robert Ferl and Anna-Lisa Paul are joint heads of the Space Plants Lab at the University of Florida, Gainesville, which already has experiments on board the ISS. These are studying how *Arabidopsis thaliana*, a species of cress that is botany's equivalent of animal scientists' mice and fruit flies, responds to the rigours of orbital free fall. The answer is that the plants switch on some genes which would normally remain dormant, while switching off others that would normally be active.

In particular, as Dr Ferl, Dr Paul and their colleagues have found, spacefaring specimens frequently divert resources away from tasks, such as strengthening the rigidity of cell walls, which are less pertinent when the directional pull of gravity is missing. Conversely, in a bid better to determine which way is "up", they become more sensitive to light. As Dr Paul puts it, plants "reach into their metabolic toolbox" to cope with the unusual stress. In doing so they pull out tools that may be used rarely on Earth, but which plant breeders might be able to deploy in advantageous

ways by improving gas exchange, inducing better root growth or reducing stem size.

The ISS will not, though, last for ever. And Nanoracks is involved in a proposal to replace it. As the name of its progeny in Abu Dhabi also suggests, this is Starlab, a putative crewed space station planned by a group led by Lockheed Martin.

Starlab is intended to be a commercial enterprise, with plant breeding as one of its sources of revenue. It is not planned to go into orbit until 2027, and the schedule for such projects is in any case almost always optimistic. But if it does get off the ground, the idea that one of its modules might, in effect, be a plant-growing annex to the main living space, akin to a conservatory on Earth, has a pleasing domesticity to it. Perhaps the crew will relax there after a hard day's work. ■



轨道上的农业科学

外太空为植物育种者提供了一些不寻常的优势

借助辐射和微重力可能培育出更好的作物

由于失去了舒适的地球引力的定向牵引，在轨道上生长的植物通常难以区分上下。这加大了它们向体内各处输送水分和营养物质的难度，还破坏了它们从空气中吸收光合作用所需的二氧化碳的能力。这一切造成的压力似乎增加了一定量辐射所诱发的基因突变水平——太空中有很多辐射，以宇宙射线和太阳电磁辐射的形式存在。而突变是植物育种员的生命线。

在地球上，育种员通过将植物与种子暴露于放射性同位素、X射线等辐射下诱发突变。大多数突变是有害的。但偶尔也会“撞大运”，赋予植物耐旱性、抗枯萎病或更短的茎等受农民欢迎的特性，以及备受消费者青睐的更甜的口味、更鲜艳的色泽或更薄的果皮。通过选择性繁殖，这样的突变被从它们的祖细胞中选出并添加到栽培品种中，价值百万。因此，诱变是一项重要的业务。

位于阿布扎比的“星际实验室绿洲”（StarLab Oasis）认为自己有可能让这项业务更上一层楼。这家公司于2021年从得州企业Nanoracks中剥离出来。正如其名字所暗示的，它计划利用太空的自然辐射来完成这项工作。其研究团队打算在今年早些时候开始向国际空间站（ISS）运送种子。抵达后，这些种子将由空间站上的宇航员培养，任其生长和繁殖。

通过这种培育方法产生的后代种子将被送回地球，并在星际绿洲实验室的温室里发芽。随后，它们将经受干旱、病原体、贫瘠土壤、高温和虫害等多重考验。那些最能经受住这些侵扰的植物继而再接受培育，以期出现有价值的东西。

这种方法的精简版已经取得了一定成功，即用卫星携带一包包种子发射升空，接受一段时间的宇宙辐射，然后再送回地球。中国表示已经执行了30多次这样的任务，至少培育出了200种改良的作物品种。不过星际实验室

绿洲的老板艾伦·赫伯特（Allen Herbert）认为，他的公司是首家采取这种方式的私人公司，更是头一家为了改良品种而干脆在太空中种植植物的公司。

此外，太空可能引起植物学家兴趣的用处并不只有诱变。应激反应本身也带来了有用的信息。

罗伯特·菲尔（Robert Ferl）和安娜-丽莎·保尔（Anna-Lisa Paul）是位于盖恩斯维尔的佛罗里达大学空间植物实验室（Space Plants Lab）的联合负责人，该实验室已经在国际空间站开展了实验。这些实验正在研究拟南芥（水芹的一种，相当于动物科学家的小鼠和果蝇）如何对轨道自由落体的严酷环境做出反应。答案是这种植物开启了一些通常会保持休眠状态的基因，同时关闭了其他通常处于活跃状态的基因。

具体来说，菲尔和保罗及其同事发现，送往太空的植物样本经常将资源从一些任务中转移出来，比如加强细胞壁的刚性，因为当不存在重力的定向牵引时，这样的任务就没那么紧要了。相反，为了更好地确定哪个方向是“上”，它们会对光线变得更敏感。正如保罗所说，植物“在自己的新陈代谢工具箱里翻找”，以应对不寻常的压力。它们拿出了在地球上可能很少用到的工具。而植物育种员或许能够对这些工具善加利用，比如改善气体交换、诱导根系生长得更好或缩减茎的大小。

但国际空间站不会永远存在下去。Nanoracks参与了一个替代它的提案。它剥离出来的那家阿布扎比的公司名字再一次给出了提示：这个方案就是星际实验室（Starlab）。这是一个预期会有人员入驻的空间站，由洛克希德·马丁（Lockheed Martin）牵头多家企业联合规划。

星际实验室意图成为一家以植物育种作为收入来源之一的商业企业。它计划要到2027年才进入轨道，而这类项目的时间表几乎总是乐观预期。但如果某天它真的升空了，那么想象一下，在它的主要生活空间旁边设有一个独立舱，专门用来种植物，类似地球上的温室，你会感受到一种家的温馨愉悦。也许航天员们在辛苦工作了一天后会去那里放松放松。■



Balancing act

Britain's government is trying to protect national security

Without throttling investment that will be tricky

ON JANUARY 4TH a new investment-screening law came into effect, heralded by the government as “the biggest shake-up of the UK’s national-security regime for 20 years”. That is no exaggeration. It marks a shift away from economic openness towards suspicion and intervention. Kwasi Kwarteng, the business secretary, said it would show members of the public that “their security remains our number one priority”. What could go wrong?

The government is seeking to stop assets vital to national security falling into hostile hands. A report in 2017 warned that “ownership or control of critical businesses or infrastructure could provide opportunities to undertake espionage, sabotage or exert inappropriate leverage”. The context is concern about Chinese investment, and pressure to fall into line with allied countries such as America, Australia and Germany that have already tightened up.

Investors in 17 sectors, including artificial intelligence and communications, will have to notify the government if they are acquiring more than 25% of a company. The government will review, and may block, the transaction. It does not matter if the company is small or the investor British. If a deal should have been brought to the government’s attention but was not, it may be voided. Companies trying to sell overseas assets used “in connection with activities” in Britain could also face review.

This new regime is very broad. It is backdated, covering deals that went through since November 2020. “National security” is undefined, and the government can intervene in deals outside the 17 named sectors, if it so

chooses. Other countries generally limit such screening to fewer sectors, to acquisitions of domestic entities and to foreign investors. The broad scope of Britain's rules reflects how hard it is to protect against evolving, ill-defined threats. But it may also complicate enforcement, especially when it comes to overseas assets.

Another risk is of deterring welcome investments. Though the forms are quite straightforward, and the upfront costs relatively reasonable—as little as a few thousand pounds for small firms—the extra steps may cause delay. Extra information may be demanded before an application is processed, for example. Moreover, the government estimates that in complex cases a full national-security assessment could cost more than £120,000 (\$160,000). Venture-capital and private-equity investors taking minority stakes in early-stage companies are especially likely to be put off, says Becket McGrath of Euclid Law, a legal firm, since they are unused to government departments nosing round deals.

Yet another worry is that uncertainty over the new system will clog it up. The government has tried to be clear in its definition of the 17 sectors where notifications are mandatory, but there will inevitably be borderline cases. Investors who fail to notify deals that should have been notified risk fines and prison time. They might therefore decide to err on the side of caution, slowing everything down. “I’m very concerned that from January 4th there’s going to be a flood of notifications,” says John Adebisi of Skadden, Arps, Slate, Meagher & Flom, a law firm.

A final risk is that the government is too enthusiastic with its red pen. Unlike some European regimes, Britain's is not supposed to be used for industrial policy: national security is supposed to be the only criterion when deciding whether to allow a deal to go ahead. But there is sufficient discretion that political pressure to reject foreign takeovers may be hard to resist.

There is no doubt that the government is planning to become more meddlesome. Since 2002, when the previous regime came into effect, there were just 12 national-security interventions. An official impact assessment published in November 2020 estimated that the annual number of notifications under the new arrangements might be as high as 1,000-1,800, with around ten subjected to formal remedies. The government claims that the new rules should encourage investment by enhancing perceptions of Britain as a stable business environment. That reputation will have to be earned. ■



平衡术

英国政府试图维护国家安全

想要同时不抑制投资会很难

一月四日，一项新的投资审查法在英国生效，英国政府宣称它是“20年来英国国家安全制度最大的一次变革”。这并无夸张。它标志着从经济开放向怀疑和干预的转变。英国商务大臣夸西·库阿腾（Kwasi Kwarteng）表示，这将向公众表明，“他们的安全仍旧是我们的第一要务”。这会有什么問題吗？

英国政府正设法阻止攸关国家安全的资产落入敌对势力手中。2017年的一份报告警告称，“对关键业务或基础设施的所有权或控制权可能会为从事间谍活动、破坏活动或施加不当影响提供机会”。这份报告问世的背景是中国投资引发担忧，在美国、澳大利亚和德国等盟国收紧审查后，英国有压力与其保持一致。

包括人工智能和通信在内的17个行业的投资者如果想要收购一家公司超过25%的股份，将必须让政府知晓。政府将审查并可能阻止交易。目标公司规模很小或投资者是英国人都一样。如果一项交易本应提请政府注意却没有这样做，那交易可能就会作废。企业如果试图出售“与在英活动有关”的海外资产也可能面临审查。

新法规的覆盖面非常广泛。它具有追溯性，自2020年11月以来的交易都在审查范围内。政府并没有定义何为“国家安全”，而且如果它愿意，它也可以干预17个指定行业之外的交易。其他国家通常将这样的审查限制在较少的部门、对国内实体的收购以及外国的投资者。英国这项法规的范围之广反映了要防范各种不断演变、定义不清的威胁有多难。但它也可能使执法变得复杂，尤其是在海外资产方面。

另一个风险是吓跑值得欢迎的投资。虽然申报表格还算简单，前期费用也相对合理——小公司只需几千英镑——但额外的步骤可能会导致延误。例

如，在申请获得受理之前，可能还需要提供额外的信息。此外，英国政府估计，针对复杂的案例，一次全面的国家安全评估的费用可能超过12万英镑（16万美元）。律师事务所Euclid Law的贝克特·麦格拉思（Becket McGrath）说，在公司早期阶段持有少数股权的风险资本和私募股权投资者尤其可能却步，因为他们不习惯新交易引来政府部门的刺探。

还有一个担忧是围绕新制度的不确定性会导致系统大堵塞。政府已试图对17个必须向政府报告的行业做出明确的界定，但不可避免地会出现难以定夺归属的案例。若投资者本应向政府申报交易却未申报，则将面临罚款和入狱的风险。因此，他们可能会宁可小心过头，在所有事情上都放慢脚步。“我非常担心1月4日开始会冒出来海量的申报。”世达国际律师事务所（Skadden, Arps, Slate, Meagher & Flom）的约翰·阿德比伊（John Adebisi）说。

最后一个风险是英国政府会太过卖力地行使自己的生杀大权。与欧洲的一些审查制度不同，英国这项法规本不应被用来实施产业政策，也就是说，国家安全应该是决定是否允许一笔交易推进的唯一标准。但政府拥有足够的自由裁量权，拒绝外国收购的政治压力可能很难抗拒。

毋庸置疑的一点是英国政府正计划变得插手更多。自2002年上一部同类法律生效以来，只发生过12起出于国家安全考虑的干预。2020年11月公布的一份官方影响评估估计，在新制度下，每年向政府申报的案件可能多达1000到1800宗，其中约有10宗需要采取正式的补救措施。英国政府声称新法规应该会加强外界认为英国商业环境稳定的看法，从而鼓励投资。这种好名声可不会平白无故从天而降。 ■



North-eastern exposure

Could China's north-east be home to its next banking disaster?

The economy is struggling, and its banks are under stress

“CABBAGE HOMES” have brought some notoriety to Hegang in recent years. Flats in the small city in China's far north-east have been selling for outrageously low prices—some for just \$3,500 apiece—earning a comparison with the cheapest items in vegetable markets. The region's economic outlook has been so poor for so long that it cannot retain residents. The city, which is in Heilongjiang province, has lost about 16% of its population in a decade. The cabbage homes were built by the government to help alleviate poverty, but they have found few takers. The local government is now struggling to make good on its debts and is restructuring its finances. In late December officials said they had stopped hiring new government employees in order to save money.

Hegang is one of many gloomy stories from China's rustbelt provinces of Heilongjiang, Jilin and Liaoning. The region bordering Russia, known for its long, bitterly cold winters, has slogged through years of depressed economic conditions as state-owned industrial plants have closed down and young people have migrated south. Poor energy infrastructure meant that companies in the area were disproportionately affected by an acute power shortage in 2021. In a desperate attempt to keep families from moving away and to spur population growth, Jilin has announced that it will hand out “marriage and birth consumer loans” of up to 200,000 yuan (\$31,500) to couples.

The destitution is also raising concerns about the region's banks, the combined assets of which amounted to 15.8trn yuan in September. Bad debts are already higher in the north-east than in any other area of China; loan-loss provisions are the lowest. Yet spotting a crisis in the making is a

tough task. Hiding bad debts is an easy trick for smaller banks. Local regulators are understaffed. And domestic credit-rating agencies cannot be counted on to identify problem lenders. In the first seven months of 2021 rating agencies downgraded just six banks. They often take action only when a lender is on the brink. Huancheng Rural Commercial Bank, based in Jilin, for instance, suddenly declared that its net profits had fallen by 42% not long after it was downgraded.

For an insider's view on China's problematic banks, look at how much investment managers at the country's biggest lenders charge smaller ones for loans. Most banks across China pay similar yields on negotiable certificates of deposit (NCDs), securities that resemble short-term loans from one bank to another, and which trade in the interbank market. Yields paid on NCDs issued by most banks across the country fell throughout 2021, signalling a decrease in perceived risk. Yet those paid by issuing banks in the three north-eastern provinces diverged from the rest throughout 2021 (see chart).

The average premium paid on one-year NCDs issued by banks in Liaoning, compared with those in healthier provinces, shot up from about 0.24 percentage points in February to 0.65 towards the end of the year, according to Enodo Economics, a research firm. Banks in Heilongjiang and Jilin have paid similar premiums. The higher yields indicate that large banks believe the local governments of the north-east may struggle to bail out their financial institutions in the event of a crisis, analysts at Enodo said. (The surveyed NCDs were all still rated as AAA, the safest possible, by rating agencies, however.)

The north-east is a prime contender to host China's next banking disaster. Of the four major bail-outs of city commercial banks since 2019, two have been based in the region. Failures of regulation and corporate governance have meant that some institutions have come under the influence of

private corporations or individuals, who have skewed their lending. Shengjing Bank, a large bank based in Liaoning with assets of 1trn yuan, has a high level of exposure to Evergrande, a failing property developer. Some of the region's lenders have lost billions of dollars when financial products have gone sour. Regulators in Liaoning recently planned to merge 12 troubled banks together in an attempt to prevent a crisis. That plan was later watered down to just two. It is unclear how the problems at the remaining ten lenders will be handled. ■



东北敞口

中国的下一次银行业灾难会发生在东北吗？

东北经济深陷困境，银行备受压力

近些年，鹤岗因为“白菜房”而走红。在这座远在中国东北一隅的小城，住宅的售价低得离谱，有的只要3500美元一套，因此被人们拿来与市场上最便宜的蔬菜相提并论。长期以来，东北地区的经济前景欠佳，人口大量外流。位于黑龙江省的鹤岗在十年内流失了约16%的人口。“白菜房”是政府为了加快脱贫而建的，但是没什么人买。当地政府目前正在努力偿还债务和重组财政。12月底，官员表示，为了节省开支，已经停止招聘公务员。

鹤岗是黑龙江、吉林和辽宁这三大老工业省份诸多惨淡故事中的一个。东北地区与俄罗斯接壤，冬季出了名地漫长酷寒，随着国有工业企业倒闭和年轻人“南漂”，多年来经济低迷，步履维艰。东北的能源基础设施薄弱，所以这里的企业在去年一轮严重电荒中受到的影响更大。吉林省竭力防止家庭外迁并刺激人口增长，宣布将发放“婚育消费贷款”，每对夫妇最高可借20万元。

经济困顿也引发了对该地区的银行健康状况的担忧。去年9月，东北的银行总资产为15.8万亿元。坏账率已经比中国其他任何地区都高，而贷款损失准备金又是最底的。但要发现正在酝酿的危机并非易事。对于小型银行来说，隐藏坏账并不难。地方监管机构人手不足。又不能指望国内信用评级机构来识别问题银行。在2021年的前七个月，评级机构仅下调了六家银行的评级。它们通常要到银行濒临危机时才会采取行动。例如，吉林的环城农村商业银行被降级后不久，突然宣布其净利润下降42%。

想了解业内人士对中国问题银行的看法，看看中国大型银行的投资经理向较小银行收取的拆出利率就知道了。中国大多数银行的可转让定期存单的收益率都很接近，这种类似于银行间短期贷款的有价证券在银行间市场进行交易。2021年全年，全国大多数银行发行的可转让定期存单收益率都有所下滑，表明感知风险有所下降。然而同样在这一年，东北三省银行所发

行的这种存单的收益却高于其他省份（见图表）。

与更健康的省份相比，辽宁省的银行发行的一年期可转让定期存单的平均溢价从去年2月的约0.24个百分点飙升至年底的0.65个，研究公司伊诺多经济（Enodo Economics）的数据显示。黑龙江和吉林省的银行也付出了类似的溢价。收益率升高表明大型银行认为一旦发生危机，东北的地方政府可能难以救助它们的银行，伊诺多的分析师表示。（然而，这些银行的可转让定期存单评级仍是最安全的AAA级。）

东北很可能是中国下一场银行业灾难的爆发地。2019年以来有四家城商行接受了大规模纾困，其中两家在东北。监管和公司治理的失败意味着一些银行受到私营公司或个人的影响，信贷结构不平衡。辽宁的大型银行盛京银行资产规模达一万亿元，它对陷入危机的房地产开发商恒大有很大的风险敞口。金融产品出现问题后，东北的一些银行损失了数十亿美元。近期为防止出现危机，辽宁省的监管机构曾计划合并12家陷入困境的银行。后来只合并了两家。目前尚不清楚其余十家银行的问题将如何解决。■



The accidental mogul

Just how big in media does Apple want to be?

The \$3trn tech firm is not playing the same game as its rivals

AS VIOLINS PLAY mournfully, Jon Stewart, an American comic, makes a mock-emotional appeal to viewers. “Every year thousands of hours of high-quality content go unwatched,” he says seriously. “Because good, hard-working people... don’t know how to find Apple TV+.”

The world’s most valuable company can afford a few jokes at its own expense. In the past year the tech colossus has raked in \$366bn in revenue, a third more than in 2020. On January 3rd its market capitalisation briefly exceeded \$3trn (see chart 1). The mere billions that it is investing in media, including a new television show hosted by Mr Stewart, represent pocket change to the Silicon Valley giant.

Yet some 300 miles (480km) down the coast in Hollywood, where executives used to snigger about the dilettantes from big-tech land up north, Apple’s dabbling in media is no joke. Though it lags well behind Netflix and the like, Apple has enough money to ride out the increasingly expensive streaming wars, which threaten to bankrupt other players. One question keeps its rivals awake at night: What does Apple want out of show business?

Apple became a big noise in music when it launched iTunes 21 years ago this week. It took a cut of songs’ sales, and shifted hundreds of millions of iPods for people to play them. Later iTunes sold movies, too, and the firm hoped to make the same model work in television, where the market is an order of magnitude larger than music. But paying for downloads was superseded by all-you-can-eat subscriptions, pioneered by Spotify in music and Netflix in TV. Unlike downloaded music or films, subscriptions could

be easily moved between platforms. So Apple, seeing little opportunity to lock consumers into its devices, sat out the streaming revolution.

Today it is back in the media game, and a bigger force than Mr Stewart's joke implies (see chart 2). Apple Music, launched in 2015, is the second-largest streamer after Spotify. Apple TV+, now two years old, is the fourth-largest video service outside China by the number of subscribers, according to Omdia, a data company. In the past couple of years Apple has made smaller media bets including Arcade, a subscription gaming package, News+, a publishing bundle, and Fitness+, which offers video aerobics classes. There is talk of an audiobooks service later this year.

Like Amazon, another tech giant with a sideline in media, Apple has been able to roll out its offerings more quickly in more countries than most of its Hollywood rivals, which have had to build direct-to-consumer businesses from scratch. And it can afford to be generous with free trials: less than a third of Apple TV+ subscribers pay for the service, Omdia believes. It has had some hits, notably "Ted Lasso", which won a string of Emmy awards in September. But it lacks a back-catalogue, leading to high rates of customer churn. Smaller competitors like Paramount+ (part of Viacom CBS) and Peacock (from NBCUniversal) have limited new offerings but decades-old libraries.

Old-media firms have been puzzled by Apple's on-off sorties into their territory, which sometimes seem half-hearted. Winning at streaming depends mainly on splurging on content. But deep-pocketed Apple spent just over \$2bn on film and TV in 2021, against Amazon's \$9bn and Netflix's \$14bn, estimates Ampere Analysis, a research company. It doesn't bother to market its efforts much. And although medialand has cooed at the executives that Apple has poached, such as Jamie Erlicht and Zack Van Amburg from Sony and Richard Plepler from HBO, Silicon Valley insiders say that Apple keeps its own top tech people on other projects.

Indeed, while Hollywood frets about Apple's next move, many in Silicon Valley wonder why it is in media at all. None of the markets is a big prize for the world's most valuable firm. The entire global recorded music industry had sales of \$22bn in 2020, less than Apple made just from selling iPads. In about a month Apple generates as much revenue as Netflix makes in a year. Apple's TV business depends on buying shows, rather than extracting rents from others' creations as it did in the iTunes days (and as it still does in its app store). And the "lock-in" effect on consumers is weak, since Apple's main media services are available on all platforms.

Apple's renewed interest in media is best explained by the transformation in the company's scale, which radically changes the calculation of which side-projects are worthwhile. Fifteen years ago, when Netflix started streaming, the billions involved in running a film studio would have represented close to a double-digit chunk of Apple's annual revenues. Back then, Silicon Valley executives would fly down to Los Angeles, thinking "We've got a big chequebook, we could go and buy a bunch of content," says Benedict Evans, a tech analyst and former venture capitalist. "And they would go and have their first meeting in LA. And the LA people would tell them the price"—at which point the tech people would go home. In 2021 Apple TV+'s estimated content budget represented 0.6% of company revenues: "play money", as Mr Evans puts it.

The cost of running a studio can therefore be justified by what are only modest benefits to Apple. Streaming subscriptions may not lock people in as strongly as iTunes purchases did, but Apple's various services still sink "meat hooks" into customers, making them spend more time with their devices and making it a bit more inconvenient to leave Apple's ecosystem, says Nick Lightle, a former Spotify executive. The iPhone itself, which generated \$192bn in sales in the past year, more than half of Apple's total revenues, is sold as a sort of subscription, points out Mr Evans. Anything that cuts churn among iPhone subscribers by even a small amount is likely

to pay for itself.

Media also makes good marketing. Producing films with Steven Spielberg and Tom Hanks reinforces Apple's premium brand. Partnerships with pop stars keep it cool. And at a time when Silicon Valley is under attack for monopolistic practices, invasion of privacy, subversion of democracy and more, Apple is churning out worthy podcasts by Malala Yousafzai, a Nobel laureate, and teaching fitness routines to children. Not many companies can think of a film studio as a public-relations arm. A \$3trn company can.

"Apple is not playing the same game as many of its other [media] competitors," says Julia Alexander of Parrot Analytics, another data firm. For one-trick rivals like Netflix, it is an uncomfortably asymmetric competition. Yet Apple's broader priorities can also hamstring its media ambitions. Apple TV+'s lack of a library could be solved by buying someone else's; the firm has been touted as a potential buyer of small studios like Lionsgate as well as giant ones like Disney. But Apple may be wary of provoking America's Federal Trade Commission (FTC), which has its sights on Silicon Valley. "If you're Apple and the FTC is looking at big tech, the last thing you want to do is make a huge acquisition," notes Ms Alexander. Lina Khan, the FTC's tech-bashing head, is examining Amazon's recent \$8.5bn purchase of MGM Studios; never mind that the target is a relative tiddler in a fragmented market. As firms vie for control of tech's next commanding heights, from decentralised Web3 to virtual reality, drawing regulators' attention by buying old TV episodes could be a strategic error.

For as long as they continue to help sell its devices and burnish its brand, Apple will keep dripping investment into its media services. Doing so will get more expensive: global spending on video content will exceed \$230bn in 2022, according to Ampere, nearly double what it was a decade ago. As smaller competitors are outspent and give up, Apple's position could even strengthen. But given its bigger ambitions in other industries, in media

Apple is likely to be satisfied to stick to its role as a supporting actor.

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无心插柳

苹果到底想在传媒业做多大大?

这家市值三万亿美元的公司和对手玩的不是同一个游戏

伴着哀婉的小提琴声，美国喜剧演员乔恩·斯图尔特（Jon Stewart）对观众做出一副深感惋惜的样子，“每年有几千小时的高质量内容没人看，”他一本正经地说，“因为勤劳善良的老百姓……不知道怎么找到Apple TV+。”

作为全球市值最高的公司，苹果花得起钱来拿自己开涮。在过去一年里，这家科技巨头取得3660亿美元的收入，比2020年增长了三分之一。1月3日，它的市值一度超越三万亿美元（见图表1）。苹果投资传媒业的区区几十亿美元（包括由斯图尔特主持的一档新电视节目）对这家硅谷巨头来说不过是个零头。

但苹果涉足传媒业可不是闹着玩的。在沿美国西海岸往南约300英里（480公里）的好莱坞，影业大佬们曾对于北边的这些科技巨头们半吊子搞影视嗤之以鼻。但是，虽然在这个领域远远落后于奈飞（Netflix）等公司，苹果有足够的资金撑过日益烧钱的流媒体大战，而其他玩家却可能搞到要破产。令对手百思不得其解的一点是：苹果想从娱乐业得到什么？

21年前的这一周，苹果推出了iTunes，在音乐产业声名大噪。它从歌曲销售中抽成，并卖出数亿台用来播放这些歌曲的iPod。后来，它又用iTunes销售电影，苹果希望同样的模式在电视领域也玩得转，毕竟电视市场比音乐大了一个数量级。但是，付费下载的模式被“吃到饱”的包年包月订阅模式取代，后者由Spotify和奈飞分别在音乐和电视领域率先开启。与下载音乐或电影不同，用户可以方便地在平台间切换订阅。苹果认为这样难以把消费者锁定在自家设备上，因而没有参与这场流媒体革命。

今天，苹果又重新加入了媒体游戏。它的影响力比斯图尔特的笑话中所说的还是要大一些的（见图表2）。2015年推出的Apple Music现在是仅次于Spotify的第二大流媒体。数据公司Omdia的统计显示，按订阅用户数计

算，推出已两年的Apple TV+是中国以外的第四大视频服务平台。过去两三年里，苹果还在传媒领域做了些小规模投资，包括游戏订阅服务Arcade、新闻聚合应用News+，以及提供视频健身课程的Fitness+。据传，苹果将在今年晚些时候推出有声读物服务。

和另一个也涉足传媒的科技巨头亚马逊一样，苹果比大多数好莱坞对手能在更多国家更迅速地推出内容，而后者必须从零开始建立直接面向消费者的业务。而且它有足够财力来大方提供免费试用：Omdia估计目前Apple TV+的用户中只有不到三分之一是付费的。Apple TV+已有一些大热作品，特别是在9月拿下一连串艾美奖项的《足球教练》（Ted Lasso）。但该平台缺乏积累下来的节目资源，导致客户流失率较高。而维亚康姆哥伦比亚广播公司（Viacom CBS）的“派拉蒙+”（Paramount+）和NBC环球集团的“孔雀”（Peacock）等小型竞争对手虽然新节目有限，但有数十年积累下来的老片库。

老牌传媒公司对苹果断断续续地——有时似乎还是心不在焉地——进军他们的地盘感到不解。要在流媒体上胜出主要靠舍得在内容上砸钱。但据研究公司安培分析（Ampere Analysis）估计，2021年，财力雄厚的苹果在电影和电视上仅支出了20多亿美元，而亚马逊为90亿美元，奈飞为140亿美元。苹果也没有太着力宣传自己在这方面的努力。尽管传媒业界对该公司挖来的高管颇为赞赏，像是索尼的扎克·范安伯格（Zack Van Amburg）和杰米·埃尔里奇（Jamie Erlicht），以及HBO的理查德·普莱普勒（Richard Plepler），但硅谷内部人士表示，苹果还是把它顶尖的技术人员继续放在别的项目上。

事实上，在好莱坞忧心苹果下一步要干什么的时候，硅谷的许多人都在奇怪它为什么要涉足传媒业。对这家全球市值最高的公司来说，哪一块媒体娱乐市场都算不上什么大奖。2020年，全球录制音乐产业的总销售额为220亿美元，还不及苹果在销售iPad一项上的收入。苹果一个月的收入差不多相当于奈飞一年的收入。苹果的电视业务依赖于购买节目，而不是像iTunes年代那样从他人的创作中抽成（苹果在它的应用商店里仍采用这种模式）。而且，因为苹果的主要传媒服务可以在所有平台上获取，对消费

者的“锁定”效应也较弱。

苹果之所以对传媒业务重燃热情，最主要的原因是公司规模的转变，这彻底改变了对不同副线业务的价值考量。15年前，当奈飞启动流媒体业务时，开一家电影公司所需的数十亿美元在苹果年收入中会占到近两位数的比例。那时，硅谷的高管们会飞到洛杉矶，想着“我们有大本支票簿，可以去买下一大堆内容”，曾做过风险投资的科技分析师本尼迪克特·埃文斯（Benedict Evans）说，“然后他们就去洛杉矶了，第一次在那儿跟人碰头开会。洛杉矶那帮人开了个价”，这时这些科技高管就打道回府了。到了2021年，Apple TV+的内容预算估计只占到公司收入的0.6%——就是些“拿来玩儿的小钱”，埃文斯说。

此时，尽管运营一家娱乐公司只有些许好处，对苹果来说也划得来了。Spotify前高管尼克·莱特尔（Nick Lightle）表示，流媒体订阅可能不会像iTunes购买那样牢牢锁定消费者，但苹果的各种服务仍然是吸引客户的诱饵，能让他们在设备上花费更长时间，更难离开苹果的生态系统。埃文斯指出，去年iPhone的销售额为1920亿美元，占苹果总收入的一半多，而iPhone的销售本身就是一种订阅模式。iPhone用户流失率哪怕只是降低一点点都会是很值得的。

传媒业务也有利于营销。联手史蒂芬·斯皮尔伯格和汤姆·汉克斯制作电影巩固了苹果的高端品牌形象。与流行歌星合作让苹果保持炫酷。而且正当硅谷被指责垄断经营、侵犯隐私、颠覆民主之际，苹果制作了诺贝尔和平奖得主马拉拉·优素福扎伊（Malala Yousafzai）的优质播客，还推出了儿童锻炼教学视频。没有多少公司可以想象拿一家电影公司来作自己的公关部门。一家市值三万亿美元的公司可以。

“苹果与其他许多（传媒）竞争对手玩的不是同一个游戏。”另一家数据公司Parrot Analytics的朱莉娅·亚历山大（Julia Alexander）指出。对于奈飞等“一招鲜”对手来说，这是一种令人不安的不对等竞争。但苹果在更多其他领域内的重点事务也可能阻碍它的传媒业雄心。Apple TV+媒体库资源不足的问题可以通过购买别家的内容来解决；据称苹果是狮门影业

（Lionsgate）等小型电影公司乃至迪士尼等电影巨头的潜在买家。但苹果可能担心惊动正紧盯硅谷的美国联邦贸易委员会（FTC）。“如果你是苹果，而FTC正对科技巨头虎视眈眈，那你肯定会尽量避免大规模收购。”亚历山大说。对科技业态度强硬的FTC主席莉娜·汗（Lina Khan）正在审查亚马逊最近以85亿美元收购米高梅电影公司的交易，尽管这里的收购目标只是这个分散的市场里一家相对较小的公司。科技公司在竞相争夺业界的下一个制高点，从去中心化的Web3到虚拟现实，如果此时为购买旧电视剧集而引来监管机构关注，那可能是个战略性错误。

只要能继续帮助销售设备，提升品牌形象，苹果将持续向它的传媒服务少量注资。这样做的成本会越来越高：根据安培分析的数据，2022年全球视频内容的支出将超过2300亿美元，相比十年前接近翻番。随着较小的对手耗尽弹药缴械投降，苹果的地位甚至会更加稳固。但鉴于苹果在其他行业更大的野心，它在传媒圈子里很可能会继续甘当配角。





Buttonwood

Why capital will become scarcer in the 2020s

Populism, climate change and supply-chain fixes will raise the long-term cost of capital

THE TROUBLE with the 12-month outlook, an obligation at this time of year, is that the forecasts will be wrong. Of course they will. In financial markets there are so many ways to err—on direction, timing or speed of change. A year is both too long and too short. Too long, because the blistering pace of the current financial-business cycle means even a well-identified idea plays out in a matter of weeks. Too short, because deep trends may take years to become fully apparent.

So let us shelve the immediate outlook and ask instead how things might change over the next decade or so. Today capital is abundant. A middle-aged global workforce has lots of savings to put to work. Low long-term interest rates and expensive assets point to a scarcity of worthwhile ways to deploy those savings. New businesses are often ideas-based and do not need a lot of capital. It can be hard to imagine this state of affairs ending. But over time capital is bound to become less abundant. Greater demand for it will come from three sources in particular: economic populism; shorter supply-chains; and the energy transition.

Start with economic populism. Thirty years ago two academic economists, Sebastian Edwards and Rudiger Dornbusch, sketched out its key elements. Above all, it is an approach that sees no constraints—such as borrowing limits or inflation—on economic growth. The Latin American populists studied by the scholars printed money to pay for public-spending binges. This ended badly. But economic populism lives on. It is in its purest form in Venezuela. Turkey seems hell-bent on embracing a version of it. Argentina never quite threw it off.

A diluted form of economic populism is becoming more evident in rich countries, too. One sign is a revival of discretionary fiscal policy. The \$1.9trn package signed in March by President Joe Biden is the crowning example. The EU's €750bn (\$900bn) recovery fund is more modest but still significant. Fiscal stimulus is back in favour because of a realisation that policy constraints, such as budget deficits, bind less when interest rates are low. But over time deficit-financed spending will start to absorb excess savings. There has also been a shift in monetary policy. You see this in a change in targets and in personnel. The old-style central banker—aloof from politics, paranoid about inflation—is all but extinct in the rich world. A new breed frets about inequality and finds reasons to be sanguine about inflation risks. Marko Papic of Clocktower Group, an investment firm, calls the shift towards stimulus the “Buenos Aires Consensus”, in contrast with the Washington Consensus, which counsels prudence.

A second factor is rising investment in business continuity. Global value chains are likely to shorten somewhat. In part this is to avoid the bottlenecks that weighed on output in 2021. Even modest near-shoring will require more capital. A general increase in working capital seems likely. Companies lost sales during the pandemic for want of stock. The interest cost of carrying inventory is now far lower than it was when business practice shifted towards lean stock levels and just-in-time supply. A national-security imperative also favours greater redundancy in supply chains, as Mr Papic points out. Rivalry between America and China is leading each country to duplicate capacity in certain key industries, such as semiconductors. Such duplication will soak up capital.

A third reason to expect capital scarcity is climate change. The transition to greener energy is essentially a capital-spending problem, argue Eric Lonergan and Corinne Sawers in a forthcoming book. Any serious attempt to arrest the climb in the global temperature requires junking the assets underpinning the carbon economy—oil rigs, coal-fired power stations,

petrol forecourts—and building a new infrastructure based on electric vehicles, wind and solar power and battery storage. A lot of capital has to be deployed to create these assets.

None of these three trends is the kind that plays out fully over a calendar year. Indeed, such are the ironies of forecasting that 2022 may furnish evidence against the capital-scarcity thesis. If the Federal Reserve raises interest rates, it will do so quite early in the business cycle, belying the idea of a populist policy tilt. Mr Biden’s “Build Back Better” spending bill may gather dust. As bottlenecks ease, security of supply may slip down companies’ lists of priorities. But today’s capital abundance cannot last for ever. Wait long enough and some forecasts are almost bound to be right. ■



梧桐

为何资本在2020年代会变得更稀缺

民粹主义、气候变化和供应链修整将增加长期资本成本

每年此时都得来一次应景的年度展望，但问题在于预测会出错。当然会错了。金融市场上，出错的机会比比皆是，例如在方向、时机或变化速度上判断失误。一年太漫长又太短暂。太长，是因为当前金融商业周期飞快更迭，即便是一个犀利的观点只消几周时间就过时了。太短，是因为深层趋势可能需要几年时间才能完全显现。

因此，我们暂且不看短期前景，而是展望一下未来十年左右的变化。现阶段资本很充裕。一个处于中年阶段的全球劳动力队伍拥有大量可用储蓄。低迷的长期利率和昂贵的资产表明缺乏利用这些储蓄的值得的方式。新企业往往基于创意来运作，不需要大量资本。或许难以想象这样的局面会终结。但假以时日，资本必然会变得没那么充裕。对资本的更大需求尤其将源于三个方面：经济民粹主义、供应链缩短，以及能源转型。

先看经济民粹主义。30年前，塞巴斯蒂安·爱德华兹（Sebastian Edwards）和鲁迪格·多恩布什（Rudiger Dornbusch）这两位学院派经济学家概述了这种模式的关键特征。其中最重要的是，它对经济增长不施加任何限制——比如借贷限制或通胀上限。学者们研究的拉丁美洲民粹主义者通过印钞来为滥用公共开支买单，结局悲惨。但经济民粹主义没有消亡。它在委内瑞拉以最纯粹的形式存在。土耳其似乎一心拥护它的某种类型。而阿根廷从未完全摆脱它。

在富裕国家，一种稀释了的经济民粹主义也日益显现。一个迹象是可自由裁定的财政政策的复苏。美国总统拜登去年3月签署的1.9万亿美元的经济救助计划就是最好的例子。欧盟7500亿欧元（9000亿美元）的复苏基金的规模要逊色些，但仍相当可观。财政刺激重获青睐，是因为人们意识到，当利率较低时，预算赤字等政策限制的约束力较小。但随着时间的推移，靠扩大赤字来支撑的开支将开始吸收过剩的储蓄。货币政策也发生了

转变，从目标和人员的变化中可以看到这一点。那种对政治漠不关心、对通胀如惊弓之鸟的老式央行官员在富国几乎绝迹。新一代央行官员担心不平等的问题，并觉得有理由对通胀风险持乐观态度。投资公司德布罗尼（Clocktower Group）的马可·帕皮克（Marko Papic）将这种向刺激政策的转变称为“布宜诺斯艾利斯共识”，与建议谨慎行事的“华盛顿共识”形成对比。

第二个因素是对业务连续性的投资日益增加。全球价值链应该会缩短一些。这在一定程度上是为了避免出现2021年那样的影响产出的瓶颈。即使是规模不大的近岸外包也需要更多的资本。营运资本看起来很可能普遍增加。疫情期间，企业因库存不足蒙受销售损失。目前持有库存的利息成本要远低于当商业模式转向精益库存和及时供应时的利息成本。正如帕皮克指出的，维护国家安全这一要务也更倾向增加供应链的冗余。中美之间的竞争正在导致两国在半导体等某些关键行业重复建设产能。这样的重复将消耗资本。

预计资本会稀缺的第三个原因是气候变化。埃里克·朗尼根（Eric Lonergan）和科琳·索尔斯（Corinne Sawers）在即将出版的一本书中指出，向更环保能源的过渡本质上是个资本支出问题。任何遏制全球气温攀升的认真尝试都需要抛弃支撑起碳经济的资产，比如石油钻井平台、燃煤发电站、加油站等，并建设基于电动汽车、风能、太阳能和电池存储的新基础设施。要创造这些资产将必须动用大量资本。

这三种趋势无一能在一个日历年内完全走完。事实上，2022年可能还会提供反驳资本稀缺论的证据——预测这档事就是这么讽刺。如果美联储加息，那也会选在商业周期之初，这与政策倾向民粹主义的看法相左。拜登的“重建美好未来”支出法案可能会被束之高阁。随着瓶颈问题的缓解，供应安全可能会从公司的优先事项表中下滑。但今天的资本充裕不可能永远持续下去。只要等得足够久，一些预测几乎一定会是对的。■



Don't panic

Video game makers must address worries about addictiveness

By sharing their data, they may pre-empt tougher regulation

NO BUSINESS WOULD welcome being compared to Big Tobacco or gambling. Yet that is what is happening to makers of video games. For years parents have casually complained that their offspring are “addicted” to their PlayStations and smartphones. Today, however, ever more doctors are using the term literally.

On January 1st “gaming disorder”—in which games are played compulsively, despite causing harm—gains recognition from the World Health Organisation (WHO), as the newest edition of its diagnostic manual comes into force. A few months ago China, the world’s biggest gaming market, announced new rules limiting children to just a single hour of play a day on Friday, Saturday and Sunday, and none the rest of the week. Western politicians worry publicly about some games’ similarity to gambling. Clinics are sprouting around the world, promising to cure patients of their habit in the same way they might cure them of an addiction to alcohol or cocaine.

Are games really addictive? Psychologists are split. The case for the defence is that this is just another moral panic. Killjoys of yore issued similarly dire warnings about television, rock 'n' roll, jazz, comic books, novels and even crossword puzzles. As the newest form of mass media, gaming is merely enduring its own time in the stocks before it eventually ceases to be controversial. Furthermore, defenders argue, the criteria used to diagnose gaming addiction are too loose. Obsessive gaming, they suggest, is as likely to be a symptom (of depression, say) as a disorder in its own right.

The prosecution retorts that, unlike rock bands or novelists, games

developers have both the motive and the means to engineer their products to make them irresistible. The motive arises from a business-model shift. In the old days games were bought for a one-off, upfront cost. These days, many use a “freemium” model, in which the game is free and money is made from purchases of in-game goods. That ties playtime directly to revenue.

The means is a combination of psychological theory and data that helps games-makers maximise that playtime. Psychologists already know quite a lot about the sorts of things that animals, including humans, find rewarding (thanks to a long line of experiments, stretching back decades to those conducted on rats and pigeons by B.F. Skinner). Smartphones and modern consoles use their permanent internet connections to funnel gameplay data back to developers. That allows products to be constantly fine-tuned and tweaked to boost spending. The industry is even beginning to use the argot of the gambling business. The biggest spenders are known as “whales”—a term that originated in casinos.

While psychologists argue the finer points of what exactly counts as addiction, and whether gaming’s design tricks cross the line, the industry should recognise that, in the real world, it has a problem, and that problem is growing. Now that gaming addiction comes with an official WHO code, diagnoses will become more common. Clinics are already reporting booming business, as lockdowns have given gamers more time to spend with their hobby. The regulatory climate for tech is getting chillier. And being lumped in the public mind, fairly or not, with gambling and tobacco will not do the industry any favours.

| *Self-interest on many levels*

It would be wise to get ahead of the discussion. A good place to start would be with hard data. Many of the studies underpinning the contention that games are addictive in a medical sense are woolly: they rely on self-

reported symptoms, contested diagnostic criteria, skewed samples and so on. Even basic questions about the amount of time and money spent by users are hard to answer. The industry has an abundance of data that could help. But gaming firms mostly keep details of how gamers behave secret, citing commercial sensitivity.

In the long run, that will prove unwise. Gaming firms should make more of their data hoard available to researchers. If—as seems likely—worries about addictiveness are overblown, it is hard to think of a clearer way of showing it. And if not, it is better for firms to recognise the problem now, and do something about it voluntarily. The alternative is that regulators will force them to act. And as China has shown, once a government is seized by a fit of moral panic, it can lash out. ■



【首文】◆别慌

电子游戏商必须直面有关上瘾的担忧

分享数据或许能让它们先发制人，避免更严格的监管

没有哪个行当会愿意被拿来跟烟草或赌博业相比。但电子游戏制作商正面对这样的境遇。多年来，父母们总会随口抱怨子女对PlayStation和智能手机“有瘾”。然而今天，越来越多的医生开始按医学意义使用这个词。

1月1日，世卫组织最新版疾病诊断手册生效，“游戏障碍”（gaming disorder，症状是强迫性地玩游戏，即使造成伤害）得到了该组织的承认。几个月前，世界上最大的游戏市场中国宣布新规，限制儿童只能在周五、周六和周日每天玩一个小时游戏，其余时间不许玩。西方政客公开表示担心某些游戏与赌博的相似性。在世界各地，治疗游戏成瘾的诊所如雨后春笋般涌现，承诺帮病人戒除打游戏的习惯，就像可能治好酒精或可卡因成瘾那样。

游戏真的会让人上瘾吗？心理学家意见不一。为游戏辩护的一方说这不过是又一场道德恐慌。昔日的扫兴鬼们也曾对电视、摇滚乐、爵士乐、漫画书、小说甚至填字游戏发出过类似的可怕警告。作为大众媒体的最新形式，游戏的争议性最终会消失，只不过眼下要熬过这段戴枷示众的时光。此外，辩方指出，用于诊断游戏成瘾的标准太不严谨。他们表示，沉迷游戏可能本身是一种障碍，但同样有可能是某种疾病（如抑郁症）的一种症状。

控方反驳说，游戏开发商和摇滚乐队或小说家不同，他们既有动机也有手段把自己的产品设计得让人难以抗拒。动机源自商业模式的转变。在过去，购买游戏是一次性支付一笔前期费用。如今，许多游戏采用“免费增值”（freemium）模式：游戏本身是免费的，要靠玩家在游戏内购买商品来赚钱。这就把游戏时间与营收直接挂钩了。

所用的手段则是心理学理论和数据的结合，有助游戏制作商最大限度地增

加玩家的游戏时间。心理学家对于包括人类在内的动物会在哪类事物中感受到奖赏满足已经有了相当多的了解——这要归功于一长串实验，可以追溯到几十年前B. F. 斯金纳（B. F. Skinner）在大鼠和鸽子身上做的实验。智能手机和现代的游戏机利用自身永不间断的互联网连接把游戏过程数据反馈给开发者，使得他们可以对产品不断做精修和微调，好让用户花更多的钱。这个行业甚至开始使用起赌博业的暗语。花钱最多的人被称为“鲸鱼玩家”——这个词起源于赌场。

心理学家这边还在更精细的层面上争论到底怎样才算上瘾，以及游戏在设计上是否要把戏越界。但此时游戏行业应该认识到，在现实世界中它确实面对一个问题，而且越来越严重。既然游戏成瘾已经有了世卫组织的官方编号，这方面的诊断将变得更加普遍。戒游戏瘾的诊所已经报告称生意大好，因为疫情封锁措施让游戏玩家有了更多时间花在自己的爱好上。科技监管日益寒气逼人。而在公众心目中游戏已经跟赌博和烟草没什么两样，不管这是否有失公允，都不会给这个行业带来任何好处。

| 多层次利己

冲到辩论场的最前沿会是明智的。硬数据会是一个很好的切入点。支撑“游戏在医学意义上具成瘾性”这一观点的研究大多很含糊，依赖当事人自述的症状、有争议的诊断标准、有偏误的采样等等。就连用户到底花了多少时间和钱这样的基本问题都很难回答。游戏行业拥有的大量数据或许可以帮助澄清状况。但游戏公司大多以商业敏感性为由，对玩家行为的细节讳莫如深。

从长远来看，这到头来将是个不明智之举。游戏公司应该将自己囤积的数据更多地向研究人员开放。如果对游戏上瘾的担忧是被夸大了（看起来很有这种可能），那么很难想象还有什么更好的方法来清楚证明这一点。如果没被夸大，那这些公司最好现在就认识到问题，并主动采取措施。不然就等监管机构迫使它们行动吧。而就像中国所展现的，一旦一个政府被一阵道德恐慌攫住，它可能会突然拳打脚踢。■



Soliciting success

Why big law will keep getting bigger in the 2020s

Record profits—and a management revolution

A MESSY WORLD is great news for those whose business is to sort through a mess. One group in particular has had a fabulous time of late. “Business demand across every market has been strong,” beams Elliott Portnoy, chief executive of Dentons, the world’s fourth-biggest law firm by revenues. In 2021 Dentons, a product of a series of combinations, including one six years ago with Dacheng, a large Chinese practice, may bring in over \$3bn in gross billings. In the past 12 months it has added 1,000 or so lawyers to its head count, which now numbers over 12,000, and opened offices around the world. It has to turn away business for lack of capacity.

Dentons is not an isolated exhibit. Big law is on a tear. The 100 biggest global firms look on track handily to surpass their combined revenues of \$128bn in 2020 (see chart). Kirkland & Ellis, an American giant which has topped the rankings in recent years, is expected to rake in annual billings of more than \$5bn, more than twice as much as in 2015. Profits for each equity partner, an industry benchmark, have risen by more than 6% at over half of the 300 biggest global firms, estimates Peter Zeughauser, a consultant who advises many of them. At the fastest-growing 75 they have shot up by double digits. Equity partners at America’s top 100 firms could take home as much as \$2.5m each on average. “Every law firm I know, every one, has had a record profit,” marvels David Wilkins of Harvard Law School, whose seminar on the legal business is popular with big-law chiefs. And this breakneck growth is coinciding with significant changes in the profession’s time-honoured ways.

The bonanza is the result of ballooning demand for legal services and falling costs. Thanks to pandemic-era restrictions, variable expenses such

as travel and entertaining clients have plummeted. Despite their starchy reputations many firms have displayed managerial flexibility. The accoutrements of the legal professions—from leather-bound tomes and yellow pads to dark suits—were readily discarded in favour of Zoom, Google docs and sweatpants. Working from home became a convenient pretext to bill around the clock.

Even as overheads have declined, demand for lawyerly advice has swelled. Firms bracing for a repeat of the drought that followed the global financial crisis of 2007-09, when only bankruptcy practices did brisk business, have instead found themselves swamped. Mergers and acquisitions (M&A), the biggest money-spinners for lawyers, will exceed \$5trn in value in 2021, obliterating the previous record of \$4.2trn in 2015. Private-equity deals, from fundraising to divestments, are booming. So are stockmarket listings (including via complex special-purpose acquisition companies, or SPACs), as well as delistings (particularly of Chinese companies from American exchanges) and relistings (of those same companies in Hong Kong or Shanghai, at the tacit behest of the Communist Party).

At the same time the law firms' non-transaction business, which has historically been more placid, is picking up. Governments around the world are preparing to regulate areas from data and diversity to climate. The European Union may soon pass two sweeping laws governing digital markets and services, which could ensnare rich clients such as Apple, Alphabet and Meta. American trustbusters are rediscovering their pep under President Joe Biden. His Chinese counterpart, Xi Jinping, is cracking down on the private sector across the board.

A global deal to make multinational companies pay more taxes and to divvy up the spoils more equitably between countries is expected to be approved in the next few months. Businesses are also under growing pressure from investors to conform to environmental, social and governance standards,

which involve new legal instruments. On top of that, Dentons foresees a “very busy trial year” in 2022. Lawyers report that the prosecution of Elizabeth Holmes, accused of fraud at her blood-testing startup, Theranos, has prompted entrepreneurs and firms touting imperfect products to seek legal advice. Ms Holmes denies the charges. If she is convicted, law firms expect such consultations to intensify.

All these “are challenges for businesses and bright spots for lawyers”, says Jeroen Ouwehand, global senior partner of Clifford Chance, a big London firm. To make the most of the brightness, law firms are shaking up their management model. In many ways, they increasingly look an awful lot like their large corporate clients.

Culturally, the biggest shake-up is taking place in the area of compensation. Large firms have historically doled out pay to partners based on seniority. The approach has many virtues, not least promoting collegiality among many people who live to argue. But it requires the richest practices such as M&A to cross-subsidise less lucrative ones. And, as one partner at a global firm puts it, “It only works if all the partners work like maniacs, and everyone is making a ridiculous amount of money.”

| *Pay scales of justice*

For the rainmakers, it increasingly does not work. Plenty of firms’ top performers are only too happy to jump ship if offered better terms. The partner says he receives a couple of emails from headhunters every week. Kirkland & Ellis and Latham & Watkins have climbed their way to the apex of the American market in part by poaching successful lawyers with the promise of paying them based on the profits they bring in. The performance-based approach, common in the corporate world (and known as “eat what you kill” in lawyerly circles), is spreading. In December Cravath, Swaine & Moore, a New York firm, and Linklaters, a London one, both stepped away from the seniority system.

Law also resembles other sectors in the way firms configure their operations. Clifford Chance runs a research-and-development office, which studies matters like how best to administer far-flung global cases (with an experienced case manager rather than a lawyer) to the feasibility of shifting financial transactions onto blockchains (the jury is out). What used to be a senior partner's well-timed whisper to the client company's board is coalescing into formal practices in new non-transaction areas. That sort of work doesn't provide the same billing rates as complicated deals, but it is consistent and growing, says Alastair Morrison, head of strategy at Pinsent Masons, a big London firm. Ashurst, an Anglo-Australian firm, has created an in-house consultancy with 60 people (including ten partners) doing anti-fraud, compliance and "remediation" (crisis management in plain English) work that used to be the preserve of accountants and consultants. In 2021 Dentons teamed up with the Albright Stonebridge Group, an advisory firm founded by Madeleine Albright, an American former secretary of state, to launch a consulting outfit. Dentons also employs 15-20 people just to seek out and manage such combinations, as well as those with other law firms.

Most such deals are international—the third way in which law firms look ever more like other global businesses. Lawyers used to follow their multinational clients to new jurisdictions. Now many are expanding preemptively, opening offices in erstwhile legal backwaters, both to serve customers and cut costs. Clifford Chance has moved some operations from expensive legal hubs such as London and New York to cheaper places like Delhi and, more recently, Newcastle. Ashurst now has as many lawyers in Australia as in Britain. It does some simpler work from Brisbane and Glasgow rather than Sydney or London. Baker McKenzie, a Chicago firm that was early to the trend, now operates in 46 countries. Dentons boasts over 200 offices in 82 countries; it praises the virtues of places once sniffed at by big-shot lawyers, such as Milwaukee.

At the heart of operations like Baker McKenzie's or Dentons' is a structure known as a Swiss *verein* (voluntary society). Branches in different countries operate under a similar name but enjoy substantial autonomy in how they are run. Firms structured this way look like an assortment of fast-food franchises rather than a unitary organisation with a strong culture; critics sometimes still deride Baker McKenzie as Baker McDonald's. But like the fast-food chain, *vereins* are at once more global and more local than more centralised rivals.

Dentons has pushed the *verein* approach particularly hard in recent years. Its name was deliberately chosen as the most memorable and easiest to pronounce from among 67 permutations of the names of former partners. In the past 12 months it has forged ties with firms in North America, Latin America and Africa, and is about to close a deal with a Vietnamese one. It has also opened new offices in Bolivia, Grenada and Uruguay. "The more global the firm, the higher the demand," says Mr Portnoy. He refers to Dentons as "polycentric": with no dominant culture, no standard pay scale, no instructions on whom to hire and, most of all, no "colonisation". It even dispenses with a headquarters. Every time you Zoom with Mr Portnoy or Joe Andrew, Dentons' global chairmen, they appear to be in a different place.

| *Firm footing*

Being on the ground has proved especially useful for Dentons and others during the pandemic, when travel restrictions limited where and how easily partners could move around. It has been especially handy for firms to have a large presence in America and China, with their vast domestic markets and relatively rapid economic rebound from covid-19. The biggest American firms, like Ellis & Kirkland or Latham & Watkins, have consolidated their position. Big Chinese ones like Yingke or King & Wood Mallesons (as well as Dentons, whose most numerous practice is in China)

remain scarce in a field dominated by America, which accounts for four in five of the top 100 firms. But they have rocketed up the revenue rankings.

The growth of vereins is making the legal profession resemble other businesses in another way. Big law is becoming not just bigger but also more concentrated. In 2020 the three biggest earners accounted for nearly 10% of the gross billings at the top 100 global firms, up from 8% five years earlier. A handful of superstar firms like Kirkland & Ellis or Dentons may increasingly dominate the league tables. They are better able to serve clients wherever and in whatever capacity they need serving, to deal with an inevitable uptick in overheads as the world puts the pandemic behind it, and to poach talent from weaker rivals. If corporate history is a guide, the high-flying legal eagles are unlikely to have their wings clipped soon.

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制胜法宝

为什么大型律师事务所会在本个十年继续壮大

创记录的利润——以及一场管理革命

对于那些以收拾乱局为业的人来说，世界混乱是件大好事。有一个群体最近过得尤其滋润。“每个市场的业务需求都很强劲。”全球收入第四高的律师事务所大成（Dentons）的CEO埃利奥特·波特努瓦（Elliott Portnoy）笑逐颜开地说道。经过一系列的合并——包括六年前与中国大型律所大成的合并——它在2021年的总收入可能超过30亿美元。在过去的12个月里，它旗下的律师人数增加了约1000人，目前总人数已经超过1.2万，并在世界各地开设了办事处。即便这样，它还是因为人手不足而不得不推掉一些业务。

大成并非个例。其他大型律所也都成绩斐然。按目前的趋势，全球百强律所应该会轻松超越它们在2020年实现的1280亿美元的总收入（见图表）。近年来高居榜首的美国大型律所凯易（Kirkland & Ellis）的年营业额预计将超过50亿美元，是2015年的两倍多。在全球最大的300家律所中，过半数的股权合伙人人均利润（一项行业基准）增长了6%以上，为其中很多律所提供咨询的彼得·佐格豪泽（Peter Zeughauser）估计。增速最快的75家律所更是突破了两位数。美国百强律所的股权合伙人人均入账可能高达250万美元。“我所知的每一家律所，是每一家，都有创记录的盈利。”哈佛法学院的大卫·威尔金斯（David Wilkins）惊叹道。他举办的法律业务研讨会会有很多大律所的头头脑脑们参加。而在这种飞速增长发生的同时，该行业由来已久的传统运营方式正在发生重大变化。

这轮大繁荣的出现缘于人们对法律服务需求的不断增长以及律所运营成本的下降。疫情期间的各种限制让差旅和客户招待等可变开支大幅减少。尽管以刻板著称，但很多律所在管理上表现灵活。皮革包边的大部头书籍、黄色便笺簿，还有深色西装，这些法律专业人士的标配很快被束之高阁，取而代之的是Zoom、谷歌文档和运动裤。居家办公成了可以24小时收账的好理由。

一边是营运开支的下降，一边是对法律咨询的需求大增。律所原本已经在准备面对自2007至2009年全球金融危机以来的又一次旱灾——当年在危机爆发后只剩专事破产清算的律所生意兴隆——没想到这一回迎来的却是大丰收。2021年，对律师而言最赚钱的并购案的交易总额将超过五万亿美元，打破先前在2015年创下的4.2万亿美元的记录。从融资到撤资的各种私募股权交易激增。同样大增的业务还有股票上市（包括通过复杂的特殊目的收购公司上市，简称SPAC）、退市（特别是中国公司从美国交易所退市）和重新上市（还是那些中国公司，它们响应中国共产党隐蔽的指示，在香港或上海上市）。

与此同时，律所历来相对平淡的非交易类业务的数量正在回升。世界各国政府正在准备对数据、多元化、气候等诸多领域开展监管。欧盟或许很快会通过两项覆盖广泛的法律来治理数字市场和服务，可能会让苹果、Alphabet和Meta等金主客户麻烦缠身。在总统拜登治下，美国的反垄断机构正在重振旗鼓。中国国家主席习近平正在全面打压私营部门。

一项全球协议预计将在未来几个月内获批，它会要求跨国公司缴纳更多税款，并在各国之间更公平地分配获利。投资者也日益对企业施压，要求它们遵守环境、社会和治理标准，这些标准会涉及新的法律文本。除此之外，大成预计2022年将是“大打官司的一年”。律师们表示，伊丽莎白·霍姆斯（Elizabeth Holmes）被控利用其血液检测创业公司Theranos欺诈后，那些兜售尚不完美的产品的企业家和公司纷纷开始寻求法律咨询。霍姆斯否认了指控。如果她被定罪，律所预期这类咨询将激增。

伦敦大型律所高伟绅（Clifford Chance）的全球高级合伙人杰伦·欧维汉德（Jeroen Ouwehand）表示，所有这些“对企业来说是挑战，对律师而言是亮点”。为充分利用亮点，律师事务所正在大力调整自己的管理模式。在许多方面，它们越来越酷似自己的大企业客户。

在行业文化层面，最大的变革发生在薪酬上。大型律所合伙人的薪资水平历来论资排辈。这种模式有很多优点，尤其是可以让地球上最擅长辩论和伸张权利的一群人共同掌权。但这需要并购等最赚钱的业务为利润较低的

业务提供交叉补贴。而且，正如一家跨国律所的一位合伙人所说，“只有当所有合伙人都是工作狂，而且每个人都赚钱到手软的时候，这种模式才行得通”。

| 薪酬正义

对于为公司带来最多利润的“造雨人”来说，这种模式越来越行不通了。如果有更优厚的待遇，律所的许多顶尖员工都非常乐意跳槽。这位合伙人表示，自己每周都会收到几封猎头发来的电子邮件。凯易和瑞生（Latham & Watkins）之所以能够登顶美国市场，原因之一是它们挖走了会赚钱的名律师，允诺会按他们带来的盈利支付报酬。这种在企业界很普遍的基于业绩的报酬方式（在律师圈被称为“论功行赏”）正在扩散开来。去年12月，纽约律所克拉维斯-斯文和穆尔（Cravath, Swaine & Moore）和伦敦律所年利达（Linklaters）都取消了年资制度。

在业务配置方面，律所也开始和其他行业的公司相像。高伟绅律所设有一个研发部门，研究如何能最好地管理遥远的国际案件（让一名经验丰富的专案经理而不是律师来负责），以及把金融交易转移到区块链上的可行性（目前尚无定论）等问题。过去，高级合伙人会找适当的时机与客户公司的董事会“耳语”，如今在新的非交易领域，这类经验技巧正在整合为规范的操作。伦敦大型律所品诚梅森（Pinsent Masons）的策略主管阿拉斯泰尔·莫里森（Alastair Morrison）表示，这类业务的收费比不上复杂的交易，但很稳定并且在增长。英澳合资律所亚斯特（Ashurst）创建了自己的咨询部门，由60人组成（包括10名合伙人），专事反欺诈、合规和“补救”（直白些说就是危机管理）等过去属于会计师和咨询师地盘的工作。2021年，大成与美国前国务卿马德琳·奥尔布赖特（Madeleine Albright）创立的咨询公司奥尔布赖特石桥集团（Albright Stonebridge Group）合作，成立了一家咨询机构。大成还雇用了15至20人，专门负责寻求和管理此类合作以及与其他律所的合作。

这类交易大多要跨国展开——这是律所看上去愈发像其他全球企业的第三个方面。律师们过去往往跟随跨国公司客户前往人生地不熟的司法辖区。如今，许多律所都在先发制人地扩张，在昔日不被重视的地方开设办事

处，这样既能服务客户，又能削减成本。高伟绅已经将一些业务从伦敦和纽约等寸土寸金的律所集中地转移到了印度德里等成本较低的地方，不久前又转移了一些业务到纽卡斯尔。亚斯特如今在澳大利亚的律师和在英国的一样多。它把一些相对简单的工作放在澳大利亚的布里斯班和英国的格拉斯哥，而不是悉尼或伦敦。芝加哥的律所贝克·麦坚时（Baker McKenzie）是这一趋势的先行者，目前它的业务遍及46个国家。大成自称在82个国家拥有200多个办事处；它还称赞美国密尔沃基等地的好处，大牌律师们曾对这些地方不屑一顾。

贝克·麦坚时或大成等律所的运营核心是所谓的瑞士法下联盟结构（即自愿加入的社团组织）。在不同国家的分部使用相似的品牌名称，但在运作上享有很大的自主权。以这种方式构建的律所看起来像一批各式各样的快餐连锁加盟店，而不是有着同一强烈文化的统一组织；贝克·麦坚时至今仍会时不时地被批评者揶揄为“贝克·麦当劳”。但就像快餐连锁店一样，联盟结构下的律所比那些集中运营的竞争对手更能做到兼顾全球化和本地化。

近年来，大成尤其积极地推行这种联盟结构。它特意从之前合伙人的名字的67种组合里挑选了一个最好记也最容易发音的作为自己的名字。在过去的12个月里，它已经与北美洲、拉丁美洲以及非洲的一些律所建立了联系，并且即将与越南的一家律所达成协议。它还在玻利维亚、格林纳达和乌拉圭新设了办事处。“律所越全球化，客户需求就越大。”波特努瓦表示。他称大成是“多中心模式”：没有主导文化，没有统一的薪资标准，不插手员工聘用，最重要的是，没有“殖民化”。它甚至不再有总部。每次你与波特努瓦或者大成的全球董事会主席乔·安德鲁（Joe Andrew）在Zoom上会面，他们似乎都在不同的地方。

| 站稳脚跟

事实证明，当新冠疫情带来的旅行限制让合伙人的活动范围受限，出行也不再那么便利的时候，能在本地提供服务对大成和其他律所来说尤其有利。由于美国和中国拥有巨大的国内市场，经济从疫情中复苏也相对较快，在这两个国家有广泛布局的律所就特别受益。凯易和瑞生等美国最大

的律所已经巩固了自己的地位。全球百强律所中有五分之四都在美国，在这个由美国主导的领域，盈科或金杜等中国大型律所（以及像大成这样在中国的员工数量最多的律所）仍然稀少。但它们的营收排名已经大幅上升。

联盟结构的扩张让这一行在另一个方面也与其他行业趋同。大型律所不仅在变得更大，也变得更集中。2020年，收入最高的三家律所占全球百强律所总营业额的近10%，而五年前为8%。凯易、大成等少数几家超级律所可能会日益雄霸各种排行榜。它们如今能更好地在任何地方为客户提供所需的任何复杂程度的服务，应对全球摆脱疫情后不可避免的营运成本回升，以及从实力较弱的竞争对手那里挖走人才。如果说企业史给出了什么指引的话，那就是这些高飞的律界雄鹰不太可能很快折翼。





Everyone's going to the Moon

In 2022 a Moonrush will begin in earnest

Countries are racing to explore Earth's closest neighbour

DURING THE cold-war space race between the Soviet Union and America, the latter's Apollo Moon missions were mostly about making a political and technological point. Having made it, they duly ceased. Now, approaching half a century after astronauts last walked on the Moon, a new age of lunar exploration is dawning. This time the goal is not just to get people and machines on or near to Earth's satellite, but also to sustain operations there.

More people are in on the action, too. South Korea's first lunar spacecraft, an orbiter, is to be launched this summer. The United Arab Emirates (UAE) hopes to become, in the autumn, the first Arab country to operate a craft on the Moon. Though this project involves other countries, Rashid, the rover in question, is being built by the UAE Space Agency in Dubai. It will carry a device called a Langmuir probe to study, in another first, the plasma of charged particles caused by the arrival at the Moon's surface of the solar wind. And Israel may also soon be represented, by Space IL, a philanthropically sponsored organisation that intends, in a couple of years' time, to land a probe on the far side of the Moon—a feat accomplished so far only by China.

The UAE's rover will be delivered by HAKUTO-R, a landing craft built by ispace, a Japanese firm, that is launched on a rocket from SpaceX, an American one. HAKUTO-R will also carry a baseball-sized rover (pictured) from Japan's space agency, JAXA. This will trundle, Star Wars-droid style, over the lunar surface. India likewise plans to put a spacecraft on the Moon in this coming year—its first attempt having (as did a previous try by Space IL) crashed into the lunar surface in 2019. Russia is another hopeful. It last

landed a vehicle, Luna-24, on the Moon in 1976, when it was part of the Soviet Union. Luna-25 is to blast off in the coming year, too.

The most ambitious Moon efforts, though, are America's. Its space agency, NASA, aims to return people there by the middle of the decade. Instead of flying direct from Earth, as Apollo did, the plan this time is to build a lunar-orbiting space station, known as Gateway. This will host a shuttle called the Human Landing System (HLS) into which astronauts will transfer for descent to the surface—where, eventually, an outpost will be established. After years of delay this project, dubbed Artemis, after the Moon goddess who was the twin of the Sun god Apollo, is beginning to move. The coming year should see at least 18 NASA-sponsored lunar missions, some of which will deliver equipment and supplies for later use. Gateway itself is scheduled for 2024.

| *Heaven can't wait*

The protective outer shell of the Habitation and Logistics Outpost (HALO), as Gateway's living space is called, is being built in Turin by Thales Alenia Space, a Franco-Italian firm, as a contribution from ESA, the European Space Agency. It will be shipped to America in October. After this casing has been fitted to the rest of HALO, and HALO in turn connected to a Power and Propulsion Element (PPE), the whole caboodle will be lifted into Earth orbit. The PPE will then draw energy from huge solar arrays to power ion thrusters that will push it slowly away from Earth, until, 11 months later, it arrives in orbit around the Moon.

ESA is also chipping in ESPRIT, a module that will allow Gateway to be refuelled once it is in lunar orbit. Canada is making the station's "external robotic system", a mechanical arm. And Thales Alenia Space is at work on a second habitable module, I-HAB—a joint project by JAXA and ESA that will likewise be attached after the station core is safely in place.

Others are expected to join in, too. For, besides kudos, participation earns access to HALO for a country's astronauts. Dave Oberg, who manages HALO operations at Northrop Grumman, NASA's prime contractor for the unit, thus describes HALO as "the first Space BnB" for lunar orbit.

To start with, the station will be inhabited for just a month a year. Automated and remotely controlled systems will run it at other times. But before long, Mr Fuller says, it should be possible to increase that period to two months. Some might reckon this brief. The International Space Station (ISS) has been continuously inhabited for more than 21 years. But the ISS orbits a mere 400km or so above Earth. Distant lunar operations will be far harder to sustain, not least because Gateway and any putative surface base will be outside the radiation-deflecting embrace of Earth's magnetic field, and will thus need heavy shielding.

| *Ignition sequence start*

Artemis I, the project's first big launch, is supposed to lift off from Cape Canaveral in a few months' time. Its scientific payload is modest: 13 small "cubesats" to gather data about things like the abundance of lunar water. But its real purpose is to evaluate NASA's massive Space Launch System (SLS) rocket and an associated crew capsule, called Orion, that is being built by Lockheed Martin. On this mission an Orion capsule will fly, uncrewed, 64,000km beyond the Moon, before returning to Earth and splashing down in the Pacific Ocean.

The follow-up to that, Artemis II, is scheduled for 2024. An SLS will launch an Orion capsule with a service module built by ESA attached to it. This will carry four astronauts, one of them Canadian, into orbit around Earth. After circling twice, to gain speed, and thus altitude, the spacecraft will shed its last stage. The crew will then conduct manoeuvres near this jettisoned stage to give them a feel for how the capsule actually handles, as well as a bit of practice for "rendezvous and proximity" operations like docking. On

this mission, it will carry astronauts some 7,400km beyond the Moon, farther from Earth than people have ever previously ventured.

Artemis II's flight will probably last ten days, though it might be extended to as much as three weeks. And if everything goes well the door will thereby open for Artemis III, a Moon landing, in 2025—probably near the lunar south pole with a crew of four who will stay for six days.

NASA says Artemis III will help it establish a permanent “first foothold on the lunar frontier”. Artemis Base Camp, as this will be named, should one day boast an unpressurised rover (for short drives with spacesuits on), a pressurised “habitable mobility platform” (for longer trips), and living quarters that are not part of a lunar lander. Eventually, it should be able to sustain four people for a month or two.

That, at least, is the plan. However, the SLS—already years late and shockingly over budget—may be beaten to its maiden flight by SpaceX's Starship system. The reusable booster of this is more powerful and much cheaper than the SLS. And a version of the crewed Starship itself has been worked into the Artemis programme as the first HLS. Contingency plans are also being laid for the crew transfer from the Orion capsule to the Starship HLS to be made directly, rather than via Gateway, in case the station is not ready in time.

Starship's existence raises questions about the whole Artemis project. One is whether the SLS is the right launcher. Another is the value of circumlunar infrastructure like Gateway. Cynics see both as being as much conduits for piping money to influential aerospace firms and politically important constituencies as they are means for returning to the Moon—a suspicion enhanced by the fact they are, in large measure, continuations of previous, cancelled, human-capable programmes, and have cost billions of dollars. If Starship proves itself in 2022 the contrast will be stark, and an alternative

approach using it or some rival private-enterprise system, and cutting out Gateway altogether, may look quite attractive.

Whichever way things turn out, however, America is not alone in its desire to operate outposts on and in orbit around the Moon. In a remarkable development, China and Russia announced in June 2021 their intention to build a joint Moonbase and space station in lunar orbit—though, according to officials, the International Lunar Research Station, as these orbital and surface outposts are collectively to be known, will not end up with people on board until at least 2036.

Luna-25 and two follow-on missions are now part of this effort. So are China's increasingly complex Chang'e missions, named, like Artemis, after a Moon goddess. The Chang'e programme's accomplishments go well beyond its operations on the Moon's far side. China has used radar to probe beneath the lunar surface. In 2020 Chang'e 5 brought some samples home. In 2024 Chang'e 6 is to begin establishing a robotic research station on the Moon.

A notable obstacle to doing all this is radiation, for it is not just people who are harmed by it. Equipment is, too. As a consequence, components developed for use in satellites operating near Earth, and thus shielded by the planet's magnetic field, are likely to fail rapidly when exposed to the rigours of deeper space. To illustrate the point, Timothy Cichan, Lockheed Martin's top designer for space exploration, observes that, despite heavy shielding, an Orion's electronics need to include so much fail-safe redundancy that the capsule's computers are actually quite slow.

| *A higher rivalry*

At one level, all of this is impressive. But both the American and the joint Chinese-Russian efforts will create little more than lunar toeholds. For something substantial and durable, local resources will be needed. Two, in

particular, might be useful.

The first is water. Its presence, in the form of ice, was confirmed in 2008 by spectroscopic analysis of a plume of material ejected from the lunar surface by an Indian “impact probe”. The Moon’s ice is concentrated at its poles, which are home to the largest number of places enjoying the permanent shadow required to stop ice evaporating. But an analysis published in 2020 suggests such refuges are also scattered across the entire lunar surface.

Water is good for more than drinking. It is scientifically interesting, because working out the dates of its arrival on the Moon, courtesy of incoming comets, will help illuminate the history of the solar system. And its molecules can be split into oxygen and hydrogen. The former is, literally, vital. The latter might be employed as rocket fuel. And bringing water from Earth would be expensive. At the moment, the cost of getting a kilogram of material from there to the Moon’s surface is about \$1.6m.

That cost is also pertinent to the second resource, the Moon’s surface itself. This crushed rock, called regolith, crushed further still and perhaps mixed with appropriate liquids, might be turned into “ink” suitable for the 3D printing of buildings.

Chang’e 8, scheduled for 2027, will test that idea. One problem is that, in the vacuum of space, liquids rapidly boil. To overcome this, ESA has run tests on Earth. These have found that sticking a printer’s nozzle beneath a layer of untreated regolith, which can then be brushed away after the ink has set, seems to protect the squirted ink long enough for it to consolidate.

An alternative approach is to do away with the liquids altogether. Some 3D printing techniques involve sintering dry powders using lasers or microwaves rather than solidifying slurrified inks. ICON, a company in Austin, Texas, is being paid by NASA to test this approach using a terrestrial

knock-off of lunar regolith.

Such efforts raise a question. Can lunar resources be owned? The Outer Space Treaty, which dates back to 1967 and has been ratified by 111 countries, including America, bans claims of sovereignty over heavenly bodies. But sovereignty and ownership are not the same thing. So America and several other countries argue that useful lunar materials are there for the taking.

There is a catch, though. The treaty stipulates space exploration be “for the benefit and in the interests of all countries”. Some see this to mean merely that exploration must be peaceable. Others push for a broader interpretation—that benefits from off-world resources must be divvied up to include non-spacefaring countries as well.

A talking shop called the Hague Space Resources Governance Working Group has discussed the matter regularly since 2016. Rather than wait for its conclusions, though, some have opted for action. Over the years, the governments of America, the UAE and Luxembourg (a country that plays host to many companies involved in space businesses, despite its small size) have passed legislation granting firms the right to extract extraterrestrial resources. In June 2021 Japan’s parliament followed suit.

And America, at least, is turning words into action. NASA has signed a contract with Lunar Outpost, a robotics company in Colorado, to provide communications and hardware such as rovers on the Moon. If all goes well, in late 2022 a Lunar Outpost rover carrying 4G communications gear for Artemis will land near the Moon’s south pole. In a side deal, it will also scoop up a shovelful of regolith, take a picture of this, and transmit that image back to NASA. This act, it is claimed, will transfer ownership of the Moon dust to the agency—for which Lunar Outpost will be paid the princely sum of 80 cents. Julian Cyrus, the firm’s head of operations, says

the transaction will be the first sale of resources in space. Not to mention a marketing coup.

America wants to get the private sector excited about an emerging “cislunar” economy. So far, this hinges mostly on government spending. But that could change. Just as the past decade has seen an expansion of commercial opportunities in orbit around Earth, so some people hope something similar will happen on the Moon. Not long ago, developing a robotic mission to the Moon took about seven years. Now three or four years is common, says Erick Dupuis, head of space-exploration development at the Canadian Space Agency. He is in charge of a kitty of C\$150m (\$117m) intended to help Canadian aerospace firms dip their bread in the lunar gravy.

| *Celestial spheres of influence*

The Moonrush, then, brings opportunity. But it also brings geopolitical jostling. Among Europe’s spacefarers, scientific goals still carry weight. Elsewhere, missions are more about power-flaunting of a sub-Apollo kind. Xavier Pasco, head of the Foundation for Strategic Research, a Parisian think-tank, reckons India, in particular, shapes its space exploration to gain an edge over its neighbours and rivals, Pakistan and China. China’s desire to erode America’s technological lead in space is no secret. As for Russia, Pavel Luzin, an expert on space policy and security in St Petersburg, says his country sees space prowess as a pillar of national power overtopped only by its nuclear weapons and UN Security Council veto.

Some observers see the spacefaring world dividing into two increasingly opposed camps. One consists of America and (at the moment) 13 other countries that have joined its Moon programme. These have signed up to the so-called Artemis Accords, a set of motherhood-and-apple-pie principles about the peaceful use of space, data sharing, mutual aid and so on. The other, less formal, camp is led by China, with Russia a junior

partner. Marco Aliberti of the European Space Policy Institute, an international quango, says that countries being wooed to join this group include Iran, Pakistan and Saudi Arabia.

There are also military risks. The Outer Space Treaty bans nuclear or other weapons of mass destruction in space. Respect for that, and also for a more general taboo against the placing in space of other types of weaponry, could be challenged by the emerging polarisation of spacefaring countries, says Sa'id Mosteshar of the London Institute of Space Policy and Law.

For its part, DARPA, an American military-research agency, has called cislunar space the "new high ground". That makes it something no power would willingly concede to an opponent. The potential for diplomatic incidents in space, albeit not cislunar on this occasion, was illustrated by a Chinese complaint in December to the UN's Office for Outer Space Affairs about two alleged close encounters between its space station, Tiangong, and satellites belonging to SpaceX's Starlink network.

America's Air Force Research Laboratory is thus developing a "Cislunar Highway Patrol System" to assist America's Space Force, the newest branch of its military establishment. Officials are cagey about the details. But this and similar programmes for deeper "space domain awareness" will, says Jaime Stearns, the laboratory's head for space vehicles, help ensure safe passage of hardware to and from the Moon.

NASA seems keen on such ideas. In 2020 it signed an agreement with the Space Force for, among other things, greater protection for lunar spacecraft. Until recently, the force's commanders assumed their responsibilities ended 36,000km from Earth, the altitude of so-called geostationary satellites, which appear to hover in the sky because they have an orbital period of 24 hours. Those days are now over. As the agreement with NASA noted, the push to the Moon multiplies the volume of space the Defence

Department must keep an eye on more than a thousandfold. If it ever existed, then, the age of innocence is past. Tentatively, but deliberately, the Final Frontier is now being pushed out.

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人人去月球

探月热将在2022年正式掀起

各国争先恐后探索地球最近的邻居【深度】

在美苏冷战时期的太空竞赛中，美国的阿波罗登月任务主要是为了彰显政治和技术优势。做到了，也就停止了。现在，距离宇航员上一次月球行走已过去了近半个世纪，月球探索的新时代正在来临。这一次的目标不仅是让人员和机器登上或靠近这颗地球的卫星，还要在那里持续开展活动。

这一次也有更多的人员参与进来。韩国的第一艘月球飞船——一架轨道飞行器——将于今年夏天发射。阿联酋希望在今秋成为第一个将飞船送上月球表面的阿拉伯国家。尽管该项目有其他国家参与，但项目所用的月球车拉希德（Rashid）正由阿联酋航天局（UAE Space Agency）在迪拜建造。它将携带一套名为朗缪尔探针（Langmuir）的设备，对太阳风到达月球表面时带来的带电粒子的等离子体展开首次研究。由慈善机构赞助的组织Space IL也可能很快将代表以色列加入登月潮，该机构打算在两三年内让探测器在月球背面着陆，迄今为止只有中国完成了这一壮举。

阿联酋的月球车将由HAKUTO-R送上月球，这是一个由日本公司ispace建造的着陆器，将由美国公司SpaceX的火箭发射。HAKUTO-R还将携带一台仅有棒球大小的月球车（见上图），由日本宇宙航空研发机构（JAXA）制造。它将像《星球大战》里的机器人那样在月球表面滚动前进。印度同样计划在今年将航天器送上月球。它的第一次尝试于2019年在月球表面坠毁（Space IL之前的一次尝试遭遇了同样的失败）。俄罗斯是另一个有登月抱负的国家。它最近一次登月的探测器是1976年的月球24号（Luna-24），当时俄罗斯还是苏联的一部分。月球25号（Luna-25）将在今年发射。

但美国的登月计划最为雄心勃勃。其航天机构美国国家航空航天局（NASA）的目标是在2025年左右送宇航员重返月球。这次登月不会像阿波罗计划那样直接从地球起飞，而是计划建造一个名为Gateway的月球轨

道空间站。它将对接一个名为人类着陆系统（HLS）的航天器，宇航员将转乘该航天器降落到月球表面，最终在那里建立一个前哨站。这个叫作阿尔忒弥斯计划（Artemis，即月亮女神，与太阳神阿波罗是双胞胎）的项目在延迟多年之后终于开始有了动静。今年应该至少会有18次由NASA出资的月球任务，其中一些是运送设备和补给供日后使用。Gateway空间站计划于2024年发射。

| 天不我待

Gateway的生活空间叫做居住和后勤前哨（HALO），其保护外壳正由法意合资公司泰雷兹阿莱尼亚宇航公司（Thales Alenia Space）在都灵建造，这是欧洲航天局（ESA）对该项目的贡献。这个外壳将于10月运往美国。待到它被安装到HALO上，HALO继而再连接到动力和推进组件（PPE）上，这一整套设备将被送上地球轨道。接下来，PPE将从巨大的太阳能电池阵列中汲取能量，驱动离子推进器，将整个设备缓慢推离地球，11个月后到达绕月轨道。

欧洲航天局还参与了ESPRIT的研发，这个模块在进入月球轨道后将为Gateway补充燃料。加拿大正在制造Gateway的“外部机器人系统”，也就是一条机械臂。泰雷兹阿莱尼亚宇航公司正在建造第二个居住舱I-HAB。该项目由JAXA和欧洲航天局联合开发，同样也会等到空间站的核心部分安全就位后再连接上去。

其他国家预计也会参与进来。因为除了可以获得荣誉之外，参与其中还能让一国的宇航员进入HALO。戴夫·奥伯格（Dave Oberg）在NASA的主承包商诺斯罗普·格鲁曼公司（Northrop Grumman）管理HALO的运营，他称HALO为月球轨道上的“首家太空B&B旅馆”。

刚开始，宇航员每年将仅能在Gateway空间站驻留一个月。在其余时间里空间站靠自动化和远程控制系统来运行。不过富勒说，不久之后宇航员的驻留时间应该可以延长到每年两个月。有些人可能认为这很短。国际空间站（ISS）已经连续有宇航员驻留超过21年了。但国际空间站的轨道距离地球仅400公里左右。在遥远的月球轨道上维持运作要难得多，一个主要原

因是Gateway和任何可能的月表基地都将位于地球磁场的辐射偏转范围之外，因此需要大量屏蔽防护。

| 点火程序开始

阿尔忒弥斯1号（Artemis I）是Gateway项目的首个重要发射任务，预计将在几个月后从卡纳维拉尔角（Cape Canaveral）发射升空。它的科学载荷不大，共有13个“立方体卫星”，用于收集月球上的水丰度等数据。但它的真正目的是对NASA的太空发射系统（SLS）大型运载火箭及所配备的猎户座（Orion）飞船进行评估，猎户座目前正由洛克希德·马丁公司（Lockheed Martin）建造。在这次任务中，猎户座将在没有宇航员的情况下在距离月球6.4万公里的地方飞行，然后返回地球，降落在太平洋上。

后续的阿尔忒弥斯2号计划于2024年发射。一枚SLS火箭将发射一艘猎户座飞船，带有一个由欧洲航天局建造的服务舱。飞船将携四名字航员进入绕地轨道，其中一名来自加拿大。在绕地球飞行两圈以加快速度从而提升高度后，飞船将与火箭末级分离。然后，宇航员将在脱离的末级附近开展一些演习，以了解飞船的实际应对，也为对接等“交会和近傍”操作做些练习。在这次任务中，飞船将把宇航员送至距离月球约7400公里处，将是人员到达过的距地球最远的位置。

阿尔忒弥斯2号的飞行任务可能会持续十天，但也可能会延长至三周。如果一切顺利，可能就会有机会在2025年执行阿尔忒弥斯3号任务来登陆月球，四名字航员可能将在月球南极附近停留六天。

NASA表示，阿尔忒弥斯3号将帮助它建立永久性的“首个月球前哨站”。这个前哨站将命名为阿尔忒弥斯大本营（Artemis Base Camp），日后应该会拥有一部无压月球车（供宇航员穿着宇航服在月球表面短途移动），一个加压的“可居住出行平台”（供长途出行），以及独立于月球登陆器的生活区。最终，这个大本营应该能够支持四名字航员工作生活一两个月。

至少计划是这样的。然而，SLS已经推迟了好几年，而且严重超出预算，

有可能在处女航上就败给SpaceX的星舰（Starship）系统。星舰可重复使用的助推器比SLS更强大，却便宜得多。载人版星舰已经作为首个HLS加入了阿尔忒弥斯计划。应急计划也在制订中，万一Gateway空间站没有及时准备就绪，宇航员就可以不用通过空间站，直接从猎户座飞船转移到星舰HLS。

星舰的存在引发了对整个阿尔忒弥斯计划的多重质疑。一是SLS是不是合适的发射系统。二是像Gateway这种绕月基础设施价值几何。质疑者认为，两者既是重返月球的途径，也是向有影响力的航空航天企业和政治上意义重大的选区输送资金的途径。而它们在很大程度上是延续了之前已被取消的人类能力探索项目，且已耗资数十亿美元，就更加剧了这种质疑。如果星舰能在2022年实施成功，对比将会很鲜明，用星舰或它的一些竞争性的私营系统来完全取代Gateway可能看起来会很有吸引力。

然而，无论事情如何发展，美国并不是唯一一个希望在月球表面和轨道上运营前哨基地的国家。一个引人注目的进展是中国和俄罗斯在去年6月宣布，计划合作建立一个月球基地和轨道空间站，不过据官员称，这些统称为国际月球科研站（International Lunar Research Station）的月球轨道和月面前哨站至少要到2036年才会有宇航员进驻。

俄罗斯的月球25号和两个后续发射任务现在都是这一合作计划的一部分。中国日益复杂的嫦娥探月工程也一样。嫦娥工程和阿尔忒弥斯一样以神话中的月亮女神命名，其成就远不止在月球背面成功着陆和开展科研。中国已经在用雷达探测月球表面之下的情况。2020年，嫦娥五号带回了一些样本。2024年，嫦娥六号将开始在月球上建立机器人运作的科研站。

所有这些努力都面临一个重大障碍——辐射。这是因为受辐射损害的不仅仅是人，还有设备。为在地球附近运行的卫星开发的组件会受到地球磁场的保护，而当它们暴露在更深空间的严酷环境中时，很可能会很快出现故障。洛克希德·马丁公司的太空探索顶级设计师蒂莫西·奇坎（Timothy Cichan）举例说，尽管有厚重的屏障，猎户座的电子设备仍需要有很大的故障安全冗余，所以飞船上的计算机实际上运算速度很慢。

| 竞争升级

在某种层面，这些努力都很了不起。但美国的计划和中俄的合作仅仅只会在月球上建立起立足点。要建立具有实质意义的耐用设施，还需要利用月球的本地资源。有两种资源可能尤其重要。

第一个是水。2008年，印度的“撞击探测器”对月球表面喷出的物质羽流进行了光谱分析，证实月球有以冰的形式存在的水。月球的冰集中在两极，那里有面积最大的永久阴影区，可以阻止冰蒸发。但2020年发表的一项分析认为，这样的阴影区在整个月球表面都有分布。

水不仅仅可以拿来饮用。它还有重大的科学意义，如果能计算出这些水随彗星撞击而来到月球的时间，将有助于揭示太阳系的历史。水分子还可以分裂成氧和氢。前者的重要性不言自明。后者也许可用作火箭燃料。而从地球带水到月球的代价太高。目前，从地球运送一公斤材料到月球表面的成本约为160万美元。

这个成本还和第二种资源有关，即月球表面本身。被称为风化层的月球碎石表面进一步粉碎后，如果混以适当的液体，或许可以变成适用于3D打印建筑物的“墨水”。

计划于2027年发射的嫦娥8号将测试这种想法。一个麻烦是，在太空的真空状态下，液体会迅速沸腾。为了克服这个问题，欧洲航天局已经在地球上做了测试。结果发现，将打印机的喷嘴插在一层未经处理的风化层下方，等墨水凝固后再把风化层刷掉，似乎可以给喷出的墨水足够久的保护来让它固结。

另一种方法是完全不用液体。一些3D打印技术会用激光或微波烧结干粉，而不是尝试固化浆状墨水。得克萨斯州奥斯汀市的ICON公司正在NASA的资助下，用地球上类似月球风化层的物质来测试这种方法。

这些尝试引出了一个问题。可以对月球资源提出所有权吗？早在1967年签订的《外层空间条约》（Outer Space Treaty）已得到包括美国在内的111个国家的批准，禁止对天体提出主权要求。但主权和所有权不是一回事。因

此，美国和其他几个国家主张，月球上有用的原料应该先到先得。

但这里有个问题。该条约规定太空探索是“为了所有国家的利益”。有些国家认为这仅仅意味着探索月球必须是和平的。其他国家则试图推行一种更广义的解释，即来自地外资源的利益必须各国一起分配，包括那些没有参与太空探索的国家。

自2016年以来，一个名为海牙太空资源治理工作组（Hague Space Resources Governance Working Group）的组织定期就此问题展开讨论。不过，有些国家选择直接采取行动，而不是等待它得出结论。多年来，美国、阿联酋和卢森堡（该国尽管是个小国，却拥有许多从事太空业务的公司）已通过立法，授权公司开采地外资源。2021年6月，日本国会也通过了类似的法案。

至少美国正在将言语转化为行动。NASA已与科罗拉多州的机器人公司Lunar Outpost签订合同，由该公司提供通信技术和月球车等硬件。如果一切顺利，2022年末，Lunar Outpost的一辆月球车将在月球南极附近着陆，为阿尔忒弥斯项目带去4G通信设备。根据附带协议，它还将挖一铲子风化土，拍下照片，然后将图像传回NASA。它声称，这样就把这一月壤样本的所有权转移给了NASA，为此Lunar Outpost将得到一大笔报酬——80美分。该公司的运营主管朱利安·赛勒斯（Julian Cyrus）表示，这将是首笔出售太空资源的交易。更不用说还是一场营销壮举了。

美国想要激发私营部门对新兴的“地月空间”经济的兴趣。到目前为止，这个领域主要还是依靠政府支出。但这可能会改变。正如过去十年里地球轨道上的商业机会不断增多一样，一些人希望在月球也会出现类似的景象。曾几何时，开发机器人登月任务需要大约七年。加拿大航天局（CSA）太空探索发展负责人埃里克·杜普伊斯（Erick Dupuis）说，现在一般三四年就可以了。他负责管理1.5亿加元（1.17亿美元）的资金，旨在帮助加拿大航空航天公司从月球这锅汤中分得一杯羹。

| 太空势力圈

因此，登月潮带来了机会。但它也带来了地缘政治竞争。在欧洲的航天国家中，科研目标仍然受到重视。而在其他国家，登月更多是为了炫耀实力，就如同一个小号的阿波罗计划。巴黎的智库战略研究基金会

（Foundation for Strategic Research）的负责人泽维尔·帕斯科（Xavier Pasco）认为，印度尤其如此，它的太空探索计划是为了获得相对其邻国及竞争对手巴基斯坦和中国的优势。中国希望削弱美国在太空领域的技术领先地位已不是什么秘密。至于俄罗斯，圣彼得堡的太空政策和安全专家帕维尔·卢津（Pavel Luzin）表示，俄罗斯将太空实力视为国家实力的支柱，其重要性仅次于该国的核武器和在联合国安理会的否决权。

一些观察家认为航天世界正在分化为两个日益对立的阵营。一个包括美国和其他13个加入其登月计划的国家。它们签署了所谓的《阿尔忒弥斯协定》（Artemis Accords），这是一系列关于和平利用空间、数据共享、互助等的似乎十分完善的原则。另一个没那么正式的阵营由中国领导，俄罗斯算是副手。半官方国际组织欧洲空间政策研究所（European Space Policy Institute）的马克·阿里贝尔迪（Marco Aliberti）说，正被拉拢加入这个阵营的国家包括伊朗、巴基斯坦和沙特阿拉伯。

另外还有军事风险。《外层空间条约》禁止在太空部署核武器或其他大规模杀伤性武器。这一规定以及更广泛的禁止在太空部署其他类型武器的规定，可能会因航天国家中浮现的两极分化而受到挑战，伦敦空间政策与法律研究所（London Institute of Space Policy and Law）的赛义德·莫斯特沙尔（Sa'id Mosteshar）说。

美国国防部下设的军事研究机构高级研究计划局（DARPA）将地月空间称为“新高地”。这让这一空间成为任何大国都不愿向对手让步的领域。12月，中国向联合国外层空间事务办公室（Office for Outer Space Affairs）投诉，称其天宫空间站与SpaceX星链（Starlink）网络的卫星发生两次近距离相遇。这显示出在太空有可能会发生外交事件，尽管这个案例并不发生在地月空间。

因此，美国的空军研究实验室（Air Force Research Laboratory）正在开发“地月空间高速公路巡逻系统”（Cislunar Highway Patrol System）以支持美国最新设立的军种太空军（Space Force）。美国官员对细节讳莫如深。但该实验室的太空飞行器负责人杰米·斯特恩斯（Jaime Stearns）表示，该系统是为更深层次“太空领域意识”制定的类似计划将有助于确保硬件设施安全进出月球。

NASA似乎对这些想法很积极。2020年，它与太空军签署了一项协议，诸多内容中就包括加强对月球航天器的保护。在不久之前，这支部队的指挥官一直认为自己的职责范围止于距地球3.6万公里处这一地球静止卫星的高度（在这一高度上卫星的轨道周期为24小时，因此似乎是悬在天空中静止不动）。那些日子已经过去了。正如与NASA达成的协议所指出的，向月球推进的努力让国防部必须密切关注的空间范围增加了一千多倍。纯真年代已经一去不复返——如果这样的年代曾经存在过的话。试探性地，却也是蓄意为之地，人类正在进军深空这一最后的疆域。





Build block better

Is a greener, faster and more decentralised alternative to Bitcoin possible?

Building better blockchains is surprisingly hard

CRYPTO IS THE key to paradise, particularly the financial kind. That, at least, is what the fans argue. Greedy intermediaries, such as banks, will be replaced by smart contracts (self-executing rules) that run on blockchains (distributed databases). This will give rise to efficient and innovative financial services, collectively called “decentralised finance” (DeFi).

The foundations of this edifice are shaky, however. Today’s blockchains may be masterworks of coding, but they are also fiendishly complex, energy-hungry and, perhaps counterintuitively, centralised. Despite years of work, crypto developers are still trying to fully overcome the trade-offs inherent in the technology.

You can think of banks as maintaining big, opaque databases that contain information on customers’ accounts and the money in them. Depositors have to trust that these institutions act in their interests. Sometimes, however, banks may not do so: they might make bad investments and collapse; or they might freeze depositors’ accounts at a government’s behest.

To their proponents, blockchains provide the basis for a type of finance that avoids such problems. Account databases would be maintained not by a central authority, but by the computers of those who use them. An account could be frozen only if a certain majority of those maintaining the blockchain agrees to do so.

For the system to work, publicly accessible blockchains have two special

features. One is a “consensus mechanism”, a way for users to agree on how to write new transactions in the database. The other is a set of incentives that keeps the system alive. Rewards need to draw in enough users to help maintain the blockchain. And penalties have to dissuade them from attacking it, say by mimicking lots of fake users in order to overwhelm the system.

In the case of the Bitcoin blockchain, the carrot is newly minted coins. Every ten minutes or so, hundreds of thousands of specialised computers called “miners” participate in a lottery to solve a mathematical puzzle. The computer that first finds a solution alerts the other miners and if they confirm the result, it updates the blockchain and is paid (every puzzle solved is rewarded with 6.25 coins, which at the time of writing was worth \$308,270). The number-crunching also acts as a stick: the greater miners want their chances of winning the lottery to be, the more they have to invest in computing gear and electricity. To rewrite the blockchain in their favour, say by faking a transaction, they would have to control more than half the mining power. Yet engineering such an attack would be expensive, and would probably bring down the system they seek to profit from.

This approach, called “proof of work”, is simple (as far as blockchains go) and has yet to be really hacked. But it has several big drawbacks. For one, it does not scale up. Bitcoin can only handle up to seven transactions per second and fees can be high. The system has also developed some forms of centralisation. Most puzzle-solving is done by a few big “pools”. These allow miners to combine their resources and increase the odds of winning the reward, but also give them the power to influence the evolution of the system (as changes are often put to a vote of sorts). Furthermore, proof of work guzzles energy. According to some estimates, Bitcoin’s electricity use is approaching that of Italy.

Power hunger and centralisation follow from the increasing returns to scale

of proof of work. These push miners to keep expanding. The more computing power they have, the higher the chance that they win a reward. The bigger they are, the more they earn and the more they can expand.

Hence the quest to come up with better blockchains. Chia, for instance, is a system based on “proof of space and time”. As with Bitcoin, the carrot is that participating users earn coins. Yet the stick is different: instead of wasting computing power, Chia wastes digital storage. It is not yet clear, though, whether Chia will prove more sustainable and less centralised than Bitcoin if it becomes widely used.

The smart digital money is therefore on another approach: proof of stake. Here decisions about updating the blockchain are made not through a computing arms race, but by a vote among the holders of a cryptocurrency. Voting power as well as the share of the rewards depend on how much holders are willing to bet on the outcome. This stake can be destroyed if a participant misbehaves. In this system both carrot and stick are the cryptocurrency itself.

Proof of stake does use much less energy. And its latest incarnations are much faster than Bitcoin: Avalanche, a blockchain that uses the approach, processes thousands of transactions a second. But it still has big problems. Coders have been attempting to shift Ethereum, the preferred blockchain for DeFi apps, from proof of work to proof of stake. Even Vitalik Buterin, one of the inventors of Ethereum, admits that proof of stake is “surprisingly complex”. That means that lots can go wrong, especially when nearly \$100bn in capital in DeFi apps must switch over. After several delays, the coders hope to make the move in 2022.

Yet this system would still tend towards centralisation. Bigger holders can reap more rewards, increasing their holdings further. This concentrates power among early buyers of a cryptocurrency and could allow them to

take control of the blockchain. Newer projects that use proof of stake are trying to find ways to avoid this. Hedera Hashgraph is governed by a consortium, much like the one that runs Visa, a credit-card network. Avalanche and Tezos seek to ensure decentralisation by making it easy for “validators”, participants who maintain the blockchain, to join.

To critics, centralisation is inevitable, even if energy inefficiency and complexity are not. The problem of increasing returns to scale will raise its head for any popular blockchain, predicts David Rosenthal, an early practitioner. “You waste all these resources only to end up with a system that is controlled by people you have even less reason to trust than those who run conventional financial institutions,” he says.

To others, a degree of centralisation may simply be a price to pay for the other advantages of blockchains. Emin Gün Sirer of Cornell University, who co-founded Ava Labs, which created Avalanche, says that the main benefit is that governments will find it harder to influence blockchains than they do conventional banks. Kevin Werbach of the Wharton School of the University of Pennsylvania says that the openness of blockchains makes it easier to develop innovative financial services. Still, if the quest to come up with better blockchains shows one thing, it is that even in crypto-paradise there is no free lunch. ■



打造更好区块

能有更环保、快速和去中心化的方案替代比特币吗？

构建更好的区块链出人意料地难

加密技术是通往天堂的钥匙，尤其是金融天堂。至少其拥护者是这么认为的。银行等贪婪的中介机构将被颠覆，取而代之的是运行在区块链（分布式数据库）上的智能合约（自动执行的规则）。这将催生出高效和创新的金融服务，统称为“去中心化金融”（简称DeFi）。

然而，加密大厦的根基并不牢固。今天的区块链在编程上堪称杰作，但也极其复杂且耗能，而且有违直觉的是，它也趋于中心化。尽管已付出多年的努力，加密技术的开发者仍在试图完全克服这项技术固有的需要平衡的问题。

你可以认为银行就是在维护一个不透明的庞大数据库，其中包含了客户账户信息和账户中的资金信息。存款人只能相信这些机构会按他们的利益行事。但有时也许会事与愿违：银行可能投资失误和破产，也可能按政府的命令冻结储户的账户。

区块链的支持者认为，以这种技术为基础，可以创造出一种能避免这类问题的金融模式。账户数据库不再由一个中央机构集中管理，而将由众多使用者的计算机共同维护。要冻结一个账户，必须得到维护区块链的用户中一定多数的同意。

为让这个系统可行，可公开访问的区块链具备两个专门特征。首先是“共识机制”，供用户就如何在数据库中写入新交易达成一致。另外是一套奖惩机制，用以保持系统持续运转。奖励因素需要能吸引到足够多的用户来共同维护区块链。而惩罚因素则必须能阻止用户攻击系统，比如通过模拟大量虚假用户来冲垮系统。

在比特币的区块链上，奖励是新挖出的比特币。大约每十分钟，几百万台

被称为“矿机”的专用计算机参加一个破解数学谜题的抽奖。最先解出答案的计算机通知其他矿机，如果答案获得确认，该计算机就可以更新区块链并获得报酬（每解出一道题会获得6.25个比特币，在笔者撰写本文时价值308,270美元）。数字运算也起到了惩罚的作用：想要扩大矿机中奖的机会，就必须增加对运算设备和电力的投资。如果要篡改区块链从中获利，例如伪造一次交易，就必须控制一半以上的挖矿算力。然而，策划这种攻击将非常昂贵，而且还可能会让他们赖以牟利的系统崩溃。

这种方法被称为“工作量证明”，它简单易行（对区块链而言）而且至今尚未被真正攻破过。但它也有几大缺点。首先，这种方法无法扩大规模。比特币每秒最多只能处理七笔交易，交易手续费可能很高。这种系统也发展出了某种形式的中心化。大多数谜题都由少数几个大型“矿池”完成解答。这使得矿工可以整合资源，增加赢得奖励的几率，但同时也赋予了它们影响系统演化的权力（因为系统的改变往往通过某种形式的投票来决定）。此外，工作量证明耗能巨大。据某些估算，比特币的耗电已接近意大利全国的耗电量。

为了取得更高回报做大量工作量证明，随之而来的便是对电力的大胃口和中心化。这促使矿机不断扩张。算力越强，就越有可能获得奖励。规模越大，赚的钱就越多，也就越有实力进一步扩张。

因此，人们开始寻找更好的区块链。例如，Chia是一个基于“空间和时间证明”的系统。与比特币一样，奖励机制是参与其中的用户可以赢得代币。不过惩罚机制不同：Chia耗费的不是算力，而是数字存储空间。然而目前还不清楚的是，如果Chia被广泛使用，能否真的比比特币更可持续、更少中心化。

因此，智能数字货币正在尝试另一种方法：权益证明。在这种机制下，更新区块链的决定不是通过算力的军备竞赛做出，而是通过加密货币的持有者投票做出。投票权和奖励份额取决于持有者对结果的押注大小。如果参与者行为不端，其押注可能会被注销。在这个系统中，加密货币既是胡萝卜也是大棒。

权益证明消耗的能源确实少很多。而使用了这种方法的最新系统也比比特币快得多：使用这种方法的区块链Avalanche每秒可以处理数千笔交易。但它仍然有很大的问题。以太坊是DeFi应用的首选区块链，开发人员一直在尝试把它从工作量证明转为权益证明。但即使以太坊的发明者之一维塔利克·巴特林（Vitalik Buterin）也承认，权益证明“出人意料地复杂”。这意味着很多环节都可能出错，尤其是考虑到DeFi应用中需要转换的资金多达近1000亿美元。几经推迟之后，开发者希望在2022年实施转换。

然而，这样的系统仍然会趋于中心化。持有的代币越多就可以获得越多回报，进而又能持有更多代币。结果就是权力向加密货币的早期买家进一步集中，让他们有可能控制这一区块链。使用权益证明的新项目正设法避免这种局面。Hedera Hashgraph由一个联盟管理，和管理信用卡网络Visa的机构很相似。Avalanche和Tezos让“验证者”（即维护区块链的参与者）更容易加入系统，以确保去中心化。

在批评者看来，即便可以避免能源浪费和复杂性，中心化也不可避免。早期从业者大卫·罗森塔尔（David Rosenthal）预测，任何受欢迎的区块链都会遭遇“规模收益递增”的问题。他表示：“浪费了这么多资源，最终得到的系统还是被一些人掌控。相比掌管传统金融机构的人，你甚至更没有理由相信他们。”

对其他人来说，一定程度的中心化或许只不过是为了区块链的其他好处而付出的代价。康奈尔大学的艾敏·居恩·塞勒（Emin Gün Sirer）是打造Avalanche的Ava Labs的联合创始人，他认为区块链的主要好处是，相比传统银行，政府将更难以影响区块链。宾夕法尼亚大学沃顿商学院的凯文·韦巴赫（Kevin Werbach）表示，区块链的开放性让人们更容易开发出创新的金融服务。尽管如此，如果说对更好的区块链的探求给出了什么启示，那就是即使加密天堂里也没有免费的午餐。■



Schumpeter

Glencore's message to the planet

Sorry, folks. Coal will remain alive and kicking

IN “THE COAL QUESTION”, written in 1865, William Stanley Jevons, a British economist, ascribed “miraculous powers” to the fuel source powering the Industrial Revolution. Coal, he wrote, stood entirely above all other commodities. Such were its superpowers, he fretted about the consequences for Britain if it ran out of the stuff. He needn't have worried. Not only has coal proved impossible to exhaust. More than a century and a half later, the largest source of carbon emissions is devilishly hard to kill off.

In 2021 the world, which was meant to “consign coal power to history” during the UN's COP26 climate summit, probably consumed more coal-fired electricity than ever before, the International Energy Agency, the world's pre-eminent energy forecaster, said in December. The strength of demand drove coal prices to record levels in October 2021. The buoyancy is expected to continue into 2022, not least because coal is a substitute for natural gas, whose price around the globe has continued to surge in the run-up to the new year.

What is bad news for the planet has been great for coal producers. With the mineral in the ascendancy, no big Western mining company has done as well for shareholders in the past 12 months as Glencore, the diversified minerals-and-metals producer valued at \$66bn that since 2018 has snapped up coal assets divested by peers like Rio Tinto, BHP and Anglo American. Quietly, given coal's increasingly grimy reputation, the Swiss-based firm is one of the unloved mineral's most resolute champions.

That makes a campaign by a tiny activist fund, Bluebell Capital, which is

trying to force Glencore to shed its coal assets, an intriguing opportunity to examine shareholder attitudes towards coal. Only a few years ago investors, especially those with environmental, social and governance (ESG) mandates, were virtually united in the opinion that big miners should withdraw from the dirtiest fossil fuel. Now they take a different view. This may be a matter of principle. It is also a sign of how fickle investors can be when ESG goals clash with the objective of maximising financial returns.

Bluebell's diagnosis is straightforward. It says that Glencore's decision to cling on to some coal assets until 2050 is "morally unacceptable and financially flawed". It believes that the firm's exposure to coal has dragged down its valuation, overshadowing the promising role that its other mining assets, such as copper and cobalt, are playing in the clean-energy revolution. It sees the appointment of Gary Nagle, only the fourth CEO in Glencore's 47-year history following Ivan Glasenberg's departure in June, as a unique opportunity to change course. Eliminating the "coal discount" and further simplifying the business could put an extra 40-45% into shareholders' pockets, it reckons.

So far, so simplistic. What it misses, though, is a recent sea change in investor views on the wisdom of owning coal. After Rio Tinto became the first big miner to abandon coal in 2018, its rivals, Glencore included, all laid out plans to curb or terminate their coal exposure. In mid-2021 Anglo took the biggest step by spinning off its South African coal assets into a newly listed company, Thungela Resources. Shareholders applauded every step of the way.

Then the unexpected happened. Thungela's shares, after a rocky start, quadrupled in value in a matter of months. Glencore, shortly after 94% of shareholders had approved its coal-reduction plans, bought out its joint-venture partners Anglo and BHP in a Colombian coal mine that will bolster its overall output from about 104m tonnes in 2021 to 122m tonnes within

two years. BHP has reportedly put its retreat from thermal coal under review because of rising prices and changing investor attitudes. In a sign of the times, Bravus Mining and Resources, a subsidiary of the Adani Group, an Indian conglomerate, said on December 27th that it was about to export coal from the Carmichael mine in Australia for the first time. It has overcome a decade of opposition from environmentalists to bring the project to fruition.

Among investors, the change of heart has come from the top. In 2020 BlackRock, the world's biggest fund manager, set out a commitment to remove mining companies that generated more than a quarter of their revenues from thermal coal from its active investment portfolio. Though it still holds huge passive stakes in coalminers (including the second biggest in Thungela), it was a powerful divestment signal. Since then, however, some investors, including BlackRock's CEO, Larry Fink, have come to the conclusion that in private hands fossil-fuel assets are likely to be less responsibly managed and more opaque than in the public markets. Mines may be expanded, rather than gradually wound down as Glencore promises to do with its coal assets. Its defenders say this is one of the main reasons Bluebell's campaign appears to have fallen on deaf ears.

They have a point. Yet as long as the strength of the coal price is adding billions to Glencore's cashflow and lining shareholders' pockets, the argument is also self-serving. It is not clear investors would be so magnanimous were prices to plunge.

Indeed, it is a fair bet that Glencore is more committed to coal than its shareholders are. Whereas many people concerned about climate change see the energy transition as a one-way street from coal power, possibly via natural gas, towards zero-carbon sources of electricity, the firm is bracingly pragmatic. It views coal as a "vital transition fuel", especially in Asia, where China and India account for two-thirds of global coal consumption.

| *Pitstop*

Glencore is right to be a realist. However much the world worries about coal, many developing countries will favour cheap energy over the clean sort if forced to choose. Glencore says it would spin out coal if shareholders demanded it. But it clearly prefers not to. Only concerted government action to tax carbon emissions and redesign energy systems will kill off king coal. ■



熊彼特

嘉能可给地球的消息

对不起了各位。煤炭依然会生龙活虎

在1865年撰写的《煤炭问题》（The Coal Question）一书中，英国经济学家威廉·斯坦利·杰文斯（William Stanley Jevons）认为这种推动了工业革命的燃料来源具有“不可思议的力量”。煤炭完全凌驾于其他所有大宗商品之上，他写道。它的超能力如此之大，令他不由地要担心如果煤炭用完了，会给英国带来什么后果。他其实大可不必担心。事实证明，煤炭不仅取之不尽，而且在超过一个半世纪之后，这个碳排放的最大源头还是极难淘汰的。

2021年举行的联合国COP26气候峰会提出了“让煤电成为历史”，但世界主要能源预测机构国际能源署在12月表示，2021年全球消耗的燃煤电力可能比以往任何时候都多。2021年10月，强劲的需求将煤炭价格推高到创纪录的水平。这样的高位预计将持续到2022年，主要原因是煤炭是天然气的替代品，而全球范围内天然气价格在新年前夕继续飙升。

这对地球来说是个坏消息，但对煤炭生产商来说再好不过了。过去12个月里，煤炭的地位扶摇直上，结果就是嘉能可（Glencore）给股东带来的价值比西方其他任何大型矿业公司都要多。这家市值660亿美元的多元化的矿产和金属生产商自2018年以来把同行剥离出的煤炭资产迅速收归囊中，包括来自力拓（Rio Tinto）、必和必拓（BHP）和英美资源集团（Anglo American）的部门。鉴于煤炭因不环保而日益声名狼藉，这家总部位于瑞士的公司一直保持低调，却是这种不受欢迎的矿物最坚定的捍卫者之一。

小规模维权基金蓝铃资本（Bluebell Capital）正试图迫使嘉能可剥离其煤炭资产。这一行动提供了一个有趣的机会，让人一探股东对煤炭的态度。就在几年前，投资者，尤其是那些在环境、社会和公司治理（ESG）方面都有要求的投资者，还几乎一致认为大型矿业公司应该退出这种最肮脏的化石燃料业务。现在他们的看法变了。这其中也许涉及原则性问题。它同

时也显现出，当ESG目标与财务回报最大化发生冲突时，投资者可以是多么地善变。

蓝铃的诊断简单明了。它认为嘉能可坚持持有部分煤炭资产直至2050年的决定“在道德上不可接受，在财务上也有缺陷”。它相信嘉能可在煤炭上的敞口拖累了其估值，而且掩盖了它的铜和钴等其他矿业资产在清洁能源革命中的光明前景。它认为嘉能可任命加里·纳格（Gary Nagle）做一把手是一个难得的改变航向的机会。纳格是嘉能可47年历史中仅仅第四位CEO，他的前任伊凡·格拉森伯格（Ivan Glasenberg）于去年6月离任。蓝铃认为，消除“煤炭折扣”并进一步简化业务可以让股东回报再增加40%至45%。

到这里一切都非常简单。不过它忽略了一点：近来投资者对持有煤炭是否明智的看法发生了巨大转变。在2018年力拓成为第一个摒弃煤炭的大型矿业公司之后，包括嘉能可在内的竞争对手都纷纷制定了限制或终止煤炭业务的计划。2021年中，英美资源集团迈出了最大的一步，将其南非煤炭资产剥离为新公司Thungela Resources挂牌上市。股东们对这一路上的每一步都表示赞赏。

之后发生的事出乎意料。Thungela的股价在经历了动荡的开局后，短短几个月里就翻了两番。在94%的股东批准了煤炭削减计划后不久，嘉能可收购了合资伙伴英美资源集团和必和必拓在哥伦比亚的一座煤矿的股份，此举会让它的煤炭总产量从2021年的1.04亿吨在两年内提高到1.22亿吨。据报道，由于动力煤价格上涨以及投资者态度转变，必和必拓已经开始重新考虑退出动力煤的计划。一个案例成了当下形势的写照：印度企业集团阿达尼集团（Adani Group）的子公司布拉夫斯矿业和资源公司（Bravus Mining and Resources）在12月27日表示，将首次从它位于澳大利亚的卡迈克尔（Carmichael）煤矿出口煤炭。这个项目被环保人士持续抵制了十年，现在终于开花结果。

在投资者当中，态度的转变源自高层。2020年，全球最大的基金管理公司贝莱德（BlackRock）承诺，将把四分之一以上收入来自动力煤的矿业公

司从其主动投资组合中剔除。尽管它仍然被动持有大量煤矿公司的股份（例如它是Thungela的第二大股东），但这是一个强有力的撤资信号。然而，从那以后，包括贝莱德的CEO拉里·芬克（Larry Fink）在内的一些投资者又得出结论称，与在公开市场中相比，由私人持有的化石燃料资产可能在管理上更不负责任，也更不透明。煤矿可能要扩张，而不是像嘉能可承诺的那样逐步关闭其煤炭资产。支持者们认为这是蓝铃的主张似乎被置若罔闻的主要原因之一。

他们说有些道理。但是，只要煤炭价格高企正在给嘉能可增加数十亿美元计的现金流，并让股东赚得盆满钵满，这种说法就有私心的成分。不知道如果煤炭价格暴跌投资者还会不会如此宽容。

其实差不多可以肯定的是，嘉能可比它的股东更热衷于煤炭。许多人担心气候变化，认为能源转型是一条从煤电（中间可能经过天然气）到零碳电力的单行道，而嘉能可着实非常务实。它将煤炭视为一种“至关重要的过渡燃料”，尤其是在亚洲，中国和印度占到全球煤炭消费量的三分之二。

| 中途加油站

嘉能可现实的态度没有错。无论世界对煤炭有多担忧，如果一定要做出选择，许多发展中国家还是会更青睐廉价能源而不是清洁能源。嘉能可表示，如果股东要求，它会剥离煤炭业务。但它显然希望不用这么做。只有各地政府协同行动，对碳排放征税，重新设计能源系统，才能铲除“煤炭王”。■



The Economist Film

Is the era of low inflation over? Part 1

The worst case scenario could be runaway inflation - like that seen in America in the period known as the Great Inflation.



经济学人视频

低通胀时代结束了吗？（上）

最糟糕的情况可能是通胀完全失控，就像“大通胀”时期的美国那样。



Bartleby

The Beatles and the art of teamwork

A new documentary on the Fab Four is a must-watch for managers, too

PAUL IS STRUMMING his guitar in a studio in London. George yawns and Ringo looks on listlessly. John is late, as usual. Suddenly, magic. A melody starts to take shape; George joins in on his guitar; Ringo claps out a beat. By the time John arrives, The Beatles' next single, "Get Back", is thrillingly recognisable.

"Get Back" provides both the standout moment and the title of a glorious new documentary by Peter Jackson, charting the days that the band spent together in January 1969, writing and recording songs for a new album. For anyone interested in music, pop culture or creativity, the film is a stocking filled with treats. When George is struggling for a line to follow "Something in the way she moves", John has advice. "Just say whatever comes into your head each time—'attracts me like a cauliflower'—until you get the right words."

Executives should watch it, too. The question of what makes a team sing is a staple of management research, and the Beatles documentary is a rare chance to watch a truly world-class team at work. It reinforces known principles, and adds some of its own.

Take the role of Ringo, for example. When he is not actually playing, the band's drummer spends most of his time either asleep or looking bewildered. When the other three musicians bicker, Ringo smiles beatifically. To a casual observer, he might appear dispensable. But musically, nothing works without him, and as a team member he softens conflict and bridges divides.

Psychological make-up matters to how teams come together. Academics at Carnegie Mellon University and the Massachusetts Institute of Technology have found that the performance of groups is not correlated with their members' average intelligence, but with characteristics such as sensitivity and how good teams are at giving everyone time to speak. Ringo provides backing; the band would be less cohesive without him.

Another principle reinforced by the film: look here, there and everywhere for inspiration. In a study from McKinsey, more than 5,000 executives were asked to describe the environment in which they had their own best experiences of being in a team. Among other things, the consultancy identified the importance of "renewal", the habit of keeping staleness at bay by taking risks, by learning from others and by innovating.

"Get Back" shows a team of superstars embracing exactly that ethos: playing the songs of other bands, grabbing ideas like magpies and happily taking the advice and help of outsiders. It is the introduction of a pianist called Billy Preston, known to the group from their early days playing in Hamburg, which really makes the recording sessions start to click. (Let's make him the fifth Beatle, suggests John. "It's bad enough with four," sighs Paul.)

A third message of the film concerns when and how to let it be. In an effort in 2016 called Project Aristotle, Google tried to define the characteristics of its most effective teams. One of its findings was that goals ought to be "specific, challenging and attainable".

When they first meet up, on the second day of 1969, the band has a task that fits these criteria snugly: to write an album's worth of new songs in just a matter of days and perform them on a TV special. But how they get there is left largely to them. That doesn't always work out. At one point Paul yearns for a "central daddy figure" to set them straight on their scheduling. But the

combination of a deadline and autonomy yields remarkable results.

There are limits to what can be learned from “Get Back”. The Beatles are not always supportive of each other—George, feeling disregarded by John and Paul, briefly quits the band. Drugs played a part in their output: LSD may be a red line for some managers. Although technical ability is not the only determinant of success, sheer talent helped. Any band with a Lennon, a McCartney and a Harrison in it would have an advantage.

But one wider lesson comes through loud and clear. The Beatles love what they do for a living. When they are not playing music, they are talking about it or thinking about it. They do take after take of their own songs, and jam constantly. Managers who think that building esprit de corps requires a separate activity from work—here-comes-the-fun time, set aside for axe-throwing or GIF battles or something equally ghastly—are missing a fundamental point. The highest-performing teams derive the greatest satisfaction not from each other, but from the work they do together. ■



巴托比

披头士以及团队合作的艺术

这部关于“拉风四人组”的新纪录片也是“高管必看”

在伦敦的一个录音棚里，保罗扫拨着吉他。乔治打着哈欠，林戈无精打采地在一边看着。约翰一如往常地迟到了。突然间，魔法显现了。旋律开始成形；乔治的吉他加入了进来；林戈打出了一个节拍。等约翰到达时，披头士的下一首单曲《归来》（Get Back）已经差不多就是你熟悉的样子了，让人不禁起了一身鸡皮疙瘩。

《归来》是彼得·杰克逊（Peter Jackson）纪录片新作中的高光时刻，最后也成了这部非常美妙的片子的片名。影片记录了披头士成员在1969年1月一起为新专辑写歌和录音的时光。任何对音乐、流行文化或创作感兴趣的人观看它都会如同老鼠掉进了米缸。当乔治想不出“她的一举一动有种魔力”下面该接什么歌词时，约翰给出了建议。“每次你脑子里浮现了什么，就说出什么——比如‘像花椰菜一样吸引着我’——直到找到最合适的词。”

高管们也该看看这部片子。管理学研究的一个主要内容就是如何能让一个团队精彩合奏，而这部关于披头士的纪录片提供了一个难得的机会，让人观察一支真正的世界级团队是怎么工作的。它强化了一些已知的原则，也补充了一些自己的原则。

以林戈这个角色为例。当这名乐队鼓手并没在演奏时，他大部分时间要么在睡觉，要么一脸茫然。当其他三位音乐家斗嘴时，他在一边乐呵呵地微笑。不经意间看到此情此景的人可能会觉得这个人可有可无。但从音乐的角度看，没他什么都做不成；而作为团队成员，他缓和了冲突，弥合了分歧。

团队若要配合默契，心理构成很重要。卡内基梅隆大学和麻省理工学院的学者发现，团队的表现与成员的平均智力水平无关，而是与其他特征相

关，如敏感度，以及是否能让每个人都有说话的机会。林戈提供了支撑；没有他，乐队的凝聚力就会减弱。

这部电影还强化了另一个原则：要四处寻找灵感。麦肯锡的一项研究请5000多名高管描述他们作为团队一份子的最佳体验是发生在什么样的环境中。这家咨询公司有诸多发现，其中之一是“更新”这一习惯的重要性，即通过冒险、向他人学习和创新来避免陈腐僵化。

《归来》展示了一支超级巨星团队是如何积极践行上述理念的：他们播放其他乐队的歌曲，不拘一格地捕捉创意，欣然接受外人的建议和帮助。直到钢琴家比利·普雷斯顿（Billy Preston，乐队早期在汉堡表演时就与他相识）加入进来，录音才真正开始有了起色。（让他成为披头士的第五个成员吧，约翰建议。“四个就够闹心的了。”保罗叹息道。）

影片传递的第三个信息是关于何时以及如何顺其自然。在2016年一个名为“亚里士多德计划”（Project Aristotle）的项目中，谷歌试图找出自己最富成效的那些团队具有什么特征。它的发现之一是工作目标应该“具体、有挑战性和可实现”。

1969年1月2日乐队第一次为新专辑碰头时，摆在它面前的任务恰好符合上述标准：在几天内写出一整张专辑的新歌，并在一档电视特别节目中表演。但是具体如何完成在很大程度上由他们自己拿主意。这种方式并不总是行得通。保罗一度渴望有一个“老爸式的核心人物”来直接告诉他们该怎么安排日程。但是最后期限和自主性相结合产生了显著的效果。

能从《归来》中学到的东西也是有限的。披头士成员也不总是相互支持——乔治觉得约翰和保罗轻视了自己，短暂地退出了乐队。他们的作品也有药物的“功劳”，而迷幻药物可能是一些管理者的红线。虽然技术能力不是成功的唯一决定因素，但纯粹的天赋很有用。任何乐队有了列侬、麦卡特尼和哈里森这般人物都会技高一筹。

但影片响亮而清晰地传达出一条更普适性的经验。披头士们热爱自己的生计。没在演奏音乐时，他们也在谈论或思考音乐。他们一遍接一遍地录制

自己的歌，不停地即兴演奏。有些管理者认为打造团队精神需要在工作之外单独组织活动——要留出找乐子的时间，用来举行扔斧子或斗图之类令人发指的活动。他们没能领会一个基本要点。表现最好的团队最大的满足感不是来自彼此，而是来自他们共同为之努力的工作。■



Metaverse landlords

Virtual-property prices are going through the roof

Investors are paying hard currency for software real estate

“RIDICULOUS AND cool.” That is the architectural brief for a new office tower under construction in the Crypto Valley, a business district of Decentraland, a virtual platform built on the Ethereum blockchain. The edifice—owned by Tokens.com, a blockchain investor—will be a cross between a nightclub in Ibiza and the Bellagio resort in Las Vegas. In a fantasy world unencumbered by something as pedestrian as physics, a rotating company logo will float above the tower as nearby clouds shoot out company-branded thunderbolts. The tower’s purpose—to provide office leases for firms and event space for crypto conferences—is humdrum by comparison.

Gamers have traded pixelated property and other digital assets for years. Now the activity has been turbocharged by the growth of unique digital artefacts known as non-fungible tokens (NFTs), and by the hype around the metaverse—a emerging virtual market which could, depending on whom you ask, ultimately generate revenues of between \$1trn and \$30trn.

Real money is changing hands. Some sales involve replicas of the physical world. Users of Legacy, an NFT-powered recreation of London, have spent \$54m on plots of land in the game (which is still in development with no launch date). SuperWorld, a virtual planet where people can buy digital versions of any place on Earth, says the average user spends some \$3,000 on property purchases. The Taj Mahal and the Eiffel Tower are selling for the cryptocurrency equivalent of around \$200,000 and \$400,000, respectively. Their current owners paid under \$400 each.

Wholly invented worlds are also drawing investors. In November Republic

Realm, a company that manages and develops digital real estate, paid \$4.3m for land in a platform called the Sandbox, the biggest virtual-property investment to date. That same month Tokens.com spent \$2.4m for a plot in Decentraland's Fashion Street district. Nightclubs and casinos where users can win virtual money line the streets of the gambling district. In its art district Sotheby's, a real-world auction house, has opened a virtual gallery. Smaller parcels that fetched around \$20 apiece when Decentraland launched in 2017 can now sell for as much as \$100,000. Somnium Space, a competing platform, reported more than \$1.8m of land sales by its users over a 30-day period in November. In other virtual worlds, concert halls stream performances by the digital avatars of pop stars such as Justin Bieber and Ariana Grande. Empty virtual shops could soon be leased by fashion houses such as Gucci, Dolce & Gabbana, Burberry and Balenciaga, all of which have sold branded items in one metaverse or other.

Will the digital-property boom last? As in the physical world, profits depend on footfall and people's willingness to spend real money. For that to happen at scale the user experience must improve. Popular metaverse platforms such as Decentraland and the Sandbox are clunky. The average user may not want to shell out on the graphics cards, virtual-reality headsets and superfast broadband that gamers use to make cyberspace feel more real.

The second risk is volatility. Virtual-property sales typically involve the exchange of the cryptocurrency unique to a given metaverse. Decentraland has MANA; Sandbox uses digital tokens known as SAND. The price of these can swing wildly, even relative to established crypto monies such as bitcoin or ether, themselves hardly a predictable asset class. They could crash to zero if a particular metaverse bombs.

To lower the risk, early investors such as Republic Realm are diversifying their holdings. The firm says it owns land in 23 metaverse platforms. But

unlike physical land, the value of which is in part a function of its scarcity, each virtual realm is in effect limitless. So, in principle, is their number. Hundreds of wannabe metaverses already exist and more will emerge as crypto technology improves. That points to a paradox. Soaring virtual-property prices are predicated on the metaverse taking off. But a booming metaverse means less scarcity and lower prices. The laws of physics may prove easier to work around than the law of supply and demand. ■



元宇宙地主

虚拟地价冲破屋顶

投资者用真金白银购买虚拟地产

“荒诞又酷炫。”一座在建办公大楼的建筑设计概要这样写道。这座大楼位于加密谷（Crypto Valley），这是建在以太坊区块链上的虚拟平台Decentraland中的一个商业区。区块链投资机构Tokens.com拥有的这座大楼将混合西班牙伊维萨岛上的夜店和拉斯维加斯的百乐宫度假酒店的风格。在一个不受乏味的物理法则束缚的幻想世界里，一个旋转的公司logo将漂浮在大楼上方，附近的云朵会发出公司品牌的闪电。相比之下，这座大楼出租办公室和提供加密技术会议场所的功能显得平平无奇。

游戏玩家交易像素化地产和其他数字资产已有多年。现在，这类活动因“非同质化代币”（以下简称NFT）这种独一无二的数字艺术品的增长和围绕元宇宙的喧嚣而大大加速。元宇宙是新兴的虚拟平台，最终产生的收入可能在一万亿至30万亿美元之间——待看你问的是谁。

交易都是真金白银的。有些买卖涉及实体世界的复制品。基于NFT的游戏Legacy要复现伦敦，它的用户已花费5400万美元在里头买地（这款游戏仍在开发中，正式发布日期未定。）在“超级世界”（SuperWorld）这个虚拟星球上，人们可以购买对应地球上任何地方的数字复制版，该平台表示其用户平均花费约3000美元购买虚拟地产。“泰姬陵”和“埃菲尔铁塔”的加密货币售价分别约合20万美元和40万美元。它们现在的主人当初购入时都花费不到400美元。

完全虚构出来的世界也吸引着投资者。去年11月，管理和开发数字房地产的公司Republic Realm在名为沙盒（Sandbox）的平台上花费了430万美元购买土地，是迄今为止最大规模的虚拟地产投资。同月，Tokens.com以240万美元在Decentraland的时尚街（Fashion Street）区域购入一块地。在博彩区的街道上，夜总会和让用户赢取虚拟货币的赌场鳞次栉比。在艺术区，现实世界里的拍卖行苏富比开设了一家虚拟画廊。2017年

Decentraland平台刚推出时，较小的地块售价约为每块20美元，现在可以卖到10万美元。据说在11月的30天里，对手平台Somnium Space的用户出售虚拟土地的收入超过180万美元。在其他虚拟世界中，音乐厅里播放着贾斯汀·比伯和阿丽亚娜·格兰德等流行明星的数字化身的表演。空置的虚拟商店也许很快会被古驰、杜嘉班纳、博柏利和巴黎世家等时尚品牌租用，它们都已在某个元宇宙中销售自己的品牌商品。

这轮数字地产热会否持续？正如在实体世界里那样，利润取决于客流和用户花费真金白银的意愿。而要让这两个数字达到规模，就必须改善用户体验。Decentraland和沙盒这类热门元宇宙平台并不好用。普通用户可能不会像游戏玩家那样，为了让虚拟空间感觉更真实而花高价购置显卡、虚拟现实头显和超高速宽带。

第二个风险是波动性。虚拟地产销售通常涉及兑换某个元宇宙平台专用的加密货币。Decentraland使用MANA币，沙盒使用名为SAND的数字代币。这些代币的价格可能大幅波动（即便是相对比特币或以太币等成熟加密货币而言），它们本身就不是可预测的资产类别。一旦某个元宇宙暴雷，相关加密货币的价值可能暴跌到零。

为了降低这种风险，Republic Realm等早期投资者正在分散投资。该公司表示它在23个元宇宙平台拥有虚拟土地。但有别于实体土地的价值在一定程度上取决于稀缺性，每个虚拟世界的大小实际上是无限的。理论上，虚拟世界的数量也是无限的。目前已有几百个在建元宇宙，随着加密技术提升，未来还会有更多。这就指向了一个悖论。虚拟地产价格飙升是以元宇宙兴起为前提的，但元宇宙的扩张意味着稀缺性和价格会降低。跟供需法则相比，打破物理法则可能还更容易一些。■



The new covid variant

Omicron causes a less severe illness than earlier variants

But it is spreading fast, and options for treating it are more limited

WITH ITS ability to escape immunity induced by past infections and vaccines, the Omicron variant of SARS-CoV-2, first detected in South Africa on November 9th, has been tearing around the world, causing record numbers of cases of covid-19 as it does so. Australia, Britain, Denmark, France, Italy and South Africa are at the forefront of this rising wave of infections. But Omicron has reached at least 113 other countries, too.

Yet despite its ominous-looking clutch of mutations, particularly in the “spike” protein it uses to attach itself to cells when infecting them, the past week has given grounds for hope that the symptoms Omicron causes are less severe than those induced by its predecessors, and that people who do get infected are thus less likely to end up in hospital, or dead. This good news is tempered by the fact that it is far more contagious than those predecessors. It will thus spread widely in coming weeks. And a higher infection rate, even of a less serious illness, could still overwhelm hospitals and cause many deaths.

| *Hope springs eternal*

Omicron’s lower severity is probably a result of changes in the virus itself, combined with high levels of immunity (from vaccination or prior infection) that have built up in human populations. A study released on December 21st by the National Institute for Communicable Diseases, in Johannesburg, for example, found, after adjustment for age, illnesses and other factors (including vaccination status and prior infection) which determine the chances of developing severe disease, that Omicron cases are 80% less likely than previous variants to require admission to hospital.

On December 22nd, work published in Britain pointed in a similar direction. Researchers from Imperial College, in London, showed that people in England who had been infected with Omicron were 40-45% less likely than those with its immediate predecessor, Delta, to be admitted to hospital for a day or more. They also had shorter stays.

When the researchers dug more deeply they also found that, broadly speaking, people who had had at least two doses of any of the three vaccines (AstraZeneca, Moderna and Pfizer) used in Britain were “substantially protected” against hospital admission, even if protection against actual infection by Omicron had been lost. The next day, Britain’s Health Security Agency concluded that those in the country catching Omicron are 55-69% less likely than people infected by Delta to need hospital care, and 31-45% less likely to go to accident and emergency units.

The findings about vaccination put a new complexion on previous concerns that antibodies raised in people jabbed against the original Wuhan strain, or who have been previously infected, will not effectively neutralise Omicron. Clive Dix, a former chairman of Britain’s Vaccine Taskforce, said, “we have seen a progressive loss of antibody neutralisation as we moved through Alpha, Beta, Gamma and Delta...but to date the vaccines all protect against severe disease and death.” Booster doses of vaccine, given in many countries, will add to protection against both infection and disease. And the Imperial team says that, as more data accumulate, it is possible the risk of the most serious outcomes of Omicron might turn out to be even lower than currently suspected—adding that remaining immune protection against more severe outcomes of infection is expected to be much higher than those against milder disease.

This good news is tempered by caveats. It is based on early data, and therefore only small numbers of hospital admissions. As of December 20th, for example, 132 British patients with Omicron had been recorded as

passing through hospital emergency departments. Of these 14 had died with covid within 28 days of diagnosis, though the precise cause of death is not always clear. The victims ranged in age from 52 to 96. Yet in Britain Omicron infections are currently concentrated in 20- to 29-year-olds. If the virus spreads to older cohorts its impact may thus worsen.

Moreover, once someone is so sick as to require hospital treatment, doctors may have fewer options available for Omicron than for its antecedents. Previous strains could often be treated with drugs called monoclonal antibodies. Omicron seems oblivious to most of these, and supplies of those that do affect it, newly developed versions made by GlaxoSmithKline and Vir Biotechnology, are limited.

The infectiousness of Omicron and the consequent speed of its spread mean that hospitals around the world are wary of an onslaught of admissions happening at a time when many staff are unavailable because they, too, have been infected. All this could have an effect on care. Scientists advising the British government have warned that covid-related admissions to hospital this winter may match or exceed previous peaks. But there is also hope that these fears may not come true.

In Denmark, for instance, although hospital-admission rates have risen, there are signs this increase is at the low end of the range of projections. And Chris Hopson, boss of NHS Providers, which represents organisations in England's National Health Service, tweeted on December 27th that though the number of patients with covid was rising, it was not doing so "precipitately". Across the country it has gone up by around 30% in a week. But many of these are people who were admitted for other reasons and are actually asymptomatic for covid, their infection having been spotted instead by a routine test. For this reason, Mr Hopson urges caution in over-interpreting admissions data.

| *Waving Omicron goodbye?*

The Omicron wave could also recede quickly. In South Africa there is a feeling that the country may have passed its peak of cases (see chart). At a pre-Christmas meeting Sir Patrick Vallance, Britain's chief scientific adviser, said there was "an apparent slowing of growth rates" of covid. Britain, and also Denmark, are both well vaccinated countries and will be watched closely in the days and weeks to come.

Omicron may do more damage in places that are poorly vaccinated—especially those where "zero-covid" strategies intended to stop infections happening at all mean there is little natural immunity around either. But ultimately, there may be a silver lining. By infecting so many people and thus potentially providing widespread immunity to the next variant of concern, Omicron may accelerate covid's transition from being a dangerous epidemic to something that is an endemic nuisance which people can learn to put up with. ■



新冠病毒新变体

奥密克戎导致的病情比之前的毒株更轻

但它传播速度快，治疗方法也更有限

新冠病毒奥密克戎变体能逃逸因自然感染和接种疫苗而获得的免疫力，在去年11月9日于南非首次发现后已肆虐全球，令感染病例数字创下新高。澳大利亚、英国、丹麦、法国、意大利和南非在这波仍在上涨的感染潮中首当其冲。但至少113个其他国家也已被奥密克戎攻入。

奥密克戎的一系列突变看似来者不善，尤其是其“刺突”蛋白发生的突变——病毒感染人体时利用这种蛋白把自己附着在细胞上。但过去一周的情况让人们有理由乐观地认为奥密克戎导致的症状比之前的毒株更轻，感染者的住院和死亡率也就更低。这本是个好消息，不过遗憾的是奥密克戎的传染性远强于之前的毒株。因此它会在未来几周广泛传播。即便症状较轻，但更高的感染率仍可能令医院不堪重负，导致大量死亡。

| 希望永存

奥密克戎症状较轻可能是病毒本身的变化加上人群免疫力提高（通过疫苗接种或之前感染病毒）的结果。例如，约翰内斯堡的南非国家传染病研究所（National Institute for Communicable Diseases）在12月21日发布的一项研究显示，在对年龄、本身所患疾病及其他影响重症几率的因素（包括疫苗接种情况以及新冠感染史）做调整后，奥密克戎病例需要住院的可能性比之前的毒株低80%。

12月22日在英国发表的研究也有类似指向。伦敦帝国理工学院的研究人员表示，英国的奥密克戎感染者需住院一天或以上的几率比之前的德尔塔毒株低40%至45%。他们的住院时间也更短。

通过更深入的分析，研究人员还发现，大体上说，如果至少接种过两剂疫苗——不论是英国使用的三种疫苗（阿斯利康、莫德纳和辉瑞）中的哪一种，那么即便无法预防感染奥密克戎，住院率也将“大大降低”。翌日，英

国卫生安全局（Health Security Agency）得出结论：英国奥密克戎感染者的住院几率较德尔塔感染者低55%至69%，去急诊室的几率也低31%至45%。

有关疫苗接种的研究结果改变了人们之前的担忧——即接种了针对最初的武汉新冠病毒株研制的疫苗或因感染所得到的抗体将无法有效中和奥密克戎。英国疫苗工作组（Vaccine Taskforce）的前主席克莱夫·迪克斯（Clive Dix）说：“我们看到，从阿尔法毒株到贝塔、伽马、德尔塔，抗体的中和作用逐步减弱……但到目前为止，疫苗都能预防重症和死亡。”许多国家都在接种疫苗加强针，这能提升对感染和重症的保护。帝国理工学院的研究团队表示，随着数据的积累，有可能显示奥密克戎导致最严重后果的风险可能比目前的猜测还要低。他们还指出，仍然留存的免疫力对重症的保护作用预计会比对轻症的高得多。

这是好消息，但还是伴有警示。以上结论基于早期数据，所以只有少量住院病例。例如，截至12月20日，英国的急诊室确诊的奥密克戎感染者有132人。其中14人在确诊后28天内死亡，不过确切死因不一定清楚。死者年龄从52岁到96岁不等。但英国的奥密克戎感染者目前主要集中在20至29岁年龄段。假如该病毒扩散到年龄较大的人群，情况就有可能恶化。

此外，一旦病情严重到要住院治疗，相比感染之前毒株的患者，医生对奥密克戎患者的治疗方法可能更少。针对之前的毒株，通常可使用名为单克隆抗体的药物治疗。这些药物似乎大多对奥密克戎不起作用，而葛兰素史克和Vir Biotechnology新研发的有效药物又供应有限。

奥密克戎的高传染力及由此而来的快速传播让世界各地的医院都在担心可能将有大量住院病人涌入，而此时许多医护人员却无法出勤，因为他们自己也被感染了。这一切可能对医疗服务造成影响。英国政府的科学顾问警告称，今冬新冠导致的住院人数可能达到或超过前几波疫情的高峰。但这些忧虑不会成真的希望还是有的。

例如，在丹麦，尽管住院率上升，但有迹象显示升幅处于预测范围中的偏

低水平。12月27日，英国国家医疗服务体系供应商组织（NHS Providers）的首席执行官克里斯·霍普森（Chris Hopson）发推文表示，新冠患者数字的确在上升，但并不是“急剧”上升。英国全国的确诊病例一周上升了约30%。但其中许多人是因为其他原因住院的，是通过常规检查发现的无症状感染者。为此，霍普森提醒大家切勿过度解读住院数据。

| 挥别奥密克戎？

这波奥密克戎感染大潮也可能迅速退去。在南非，人们感觉似乎病例高峰已过（见图表）。圣诞节前的一次会议上，英国政府首席科学顾问帕特里克·瓦兰斯爵士（Sir Patrick Vallance）说，新冠病例“增速明显放缓”。英国和丹麦的疫苗接种率都很高，未来几天和几周内的疫情走势将受到密切关注。

在疫苗接种率低下的地方，奥密克戎可能造成更大的损害——尤其是那些为了彻底阻止感染而采取“清零”策略的地方，人们也没有自然免疫力。但最终，不幸之中仍可能有一线光明。通过感染大量人群，并因此可能让人们普遍获得对下一个重要变异株的免疫力，奥密克戎可能会加速新冠肺炎的转变，使之从一种危险的区域性流行病，变成一种人们能慢慢习惯与之共存的常态化地方性流行病。■



Fighting fit

How to prevent conflict on the way to Mars

Missions to the red planet will need a new breed of astronaut

THE EARLY days of the American space programme—days of white-knuckle test flights and solo orbital missions—called for pilots with qualities such as supreme self-confidence, unflinching bravado and ice in their veins. Or, to put it less kindly, “narcissism, arrogance and interpersonal insensitivity”. That was the assessment of one of NASA’s first staff psychiatrists, Patricia Santy, in her book “Choosing the Right Stuff”.

Yet as the space programme has grown up, so have the astronauts. And they are continuing to evolve with their missions. The next giant leap—travelling to Mars—will require people made of very different stuff from their predecessors. They must survive not only deep space but one another’s company. It took Apollo 11 about three days to get to the Moon and two days to make it back. A voyage to Mars will probably be an 18-month round trip in a spacecraft no larger than a small house, as well as perhaps a year spent on the planet.

Rotations on the International Space Station last about six months, so many astronauts have become used to long stretches in space. But a mission to Mars will add new complications. Crews on the space station have real-time contact with experts on Earth to help them manage whatever comes up. As the Mars crew ventures deeper into space, gaps in their communications with mission control will grow to 20 minutes or more; crews will need to be able to co-operate without support to solve unforeseen problems.

“There’s going to be some conflict, there’s no doubt about it,” says Noshir Contractor, a behavioural scientist at Northwestern University, in Illinois,

who works with NASA to help crews in space co-operate. The trick, he says, is not to avoid conflict but to manage it.

When engineers design a spacecraft, they do so first on a computer so they can consider every variable and understand how the machine might behave in different scenarios. NASA is trying something similar in building crews. Its researchers are creating computer models of how different people interact when confined together, and using those models to predict conflict and optimise performance over a long mission.

Humans are more complicated than spacecraft. But Dr Contractor likens his work to weather-forecasting. Weather is a complex, non-linear interaction of factors including air temperature, pressure and wind speed. Yet models can reliably predict next week's temperatures and chances of rain. Meteorologists turned to computers in the 1950s; social scientists began computerising "human factors" a decade ago.

Effective computer models demand a lot of data, so NASA has created a supply. Inside Building 220 at the Johnson Space Centre in Houston, Texas, is a structure three storeys high and 14 metres long, composed of two standing cylinders connected by a third lying on its side. Called the Human Exploration Research Analogue (HERA), it is a laboratory in which crews perform mock space missions of a few days to a few months. They are confined to the laboratory, eat only space food and follow a minute-by-minute itinerary of tasks and exercise. Monitored by cameras and microphones night and day, they are routinely prodded, physiologically and psychologically. Vibrations, sound effects and communication delays with a mock mission control add to the realism, and the stress. Dr Contractor calls HERA the "ultimate human Petri dish".

With no one to complain to about their colleagues, teams in HERA work, live, eat and solve problems together. In one experiment, four-member

crews participated in mock 30-day missions to an asteroid called Geographos, where they collected rock samples and simulated spacewalks. They faced communications delays with Earth of up to five minutes each way, and at one point underwent 24 hours of sleep deprivation.

So what have these models and experiments revealed? Conflict within a team is not always a bad thing. Happy teams are not necessarily the most productive. “If we're going to draw an arrow of causality, it's stronger to reword the statement as ‘a productive team is a happy team,’” says Leslie DeChurch, a psychologist at Northwestern University. “Nothing builds cohesion in a team like excellence.”

Avoiding conflict can discourage the creative friction that can generate new or better ideas. Conflict associated with tasks is different from that associated with personalities. Conflict over ideas can be helpful. But when conflicts get personal, things can get ugly.

In both the leader and the crew, psychologists look for people who are able to read what others are thinking of them—or “self-monitor”. Those who are good at self-monitoring can often tell, for example, whether they are intimidating others into silence, and then find ways to put them at ease. It turns out that they are also people others enjoy working with.

Psychologists also measure conscientiousness. That may sound like a crucial quality for a trip to Mars. But, on average, crew members selected these days for missions in HERA score moderately in this respect.

Research in HERA has shown that people who score very highly on conscientiousness are more likely to be seen by others as a hindrance. To others, the conscientious person can feel like a nag. A good combination of personality traits mixes a degree of conscientiousness with high self-monitoring capability. That person can critique others' work without

crossing lines—lines which each crew member may define differently.

Successful teams for space missions will require constant tweaking. You cannot dispatch perfect crew members and expect them to remain that way for years. In repeatedly testing participants in HERA, researchers found that certain skills within a team, such as creative thinking and problem-solving, tend to decline about halfway through a mission. The reason? Probably living in a low-stimulation environment, eating the same foods and looking at the same people and the same dark sky every day. Knowing that a team's performance can be dynamic—however good it might be at the start—crews on Mars missions will have to find ways to keep firing up each other's imaginations.

Based on its HERA experiments, NASA believes it can now feed prospective crew members' physical, intellectual and personality traits into its model and, with 75% accuracy, predict who will clash with whom during a mission.

Equipped with such information, Dr Contractor's team is trying to come up with ways to mitigate problems, including by tweaking the "playbook" given to crew members. This is the hour-by-hour schedule that lays out details of tasks, including who will work when with whom. If the model shows, say, that team members A and B will come to blows by day ten, researchers can tweak the playbook for that day to pair A with C instead. Or the task itself could be switched to one in which both A and B are highly skilled; success breeds camaraderie. A third option is to put A and B together with D, a crew member they both like who can broker and mend their relationship. Re-pairing crew members can repair teams, as Dr Contractor puts it.

| *Everyone can hear you scream*

The idea of being stuck in small spaces with the same people for a long

time has a chilling ring of familiarity. And there are lessons from the space programme that might apply to terrestrial life during a pandemic.

First is the need for routines, not just for work but for cooking or downtime, too. Planned routines provide structure and are central to space missions. HERA's playbook tells crews exactly what they will be doing hour by hour, including work, meals and fun.

At the same time, good communication and an ability to adjust are critical. On December 28th 1973, the three crew members of Skylab, the first American space station, declared a "work slowdown" and cut off contact with ground control, refusing to do their assigned tasks. They had become frustrated by their workload and complained bitterly to each other but kept those complaints from their colleagues on Earth.

Perhaps the most important insight NASA has gleaned from studying team dynamics—in space and on Earth—is the preciousness of one trait in particular: a sense of humour. Studies of crews overwintering at the South Pole show that a confined group needs people to fulfil various roles, including leader, storyteller and social secretary. But the most important task by far is that of the clown, a person who is funny and also wise enough to understand each member of the group and defuse tensions. Laughter, as much as courage, will sustain astronauts on their long quest to Mars.

ILLUSTRATION: PATRICK LEGER ■



打成一片

如何在飞往火星的旅途中避免冲突

探索这颗红色星球的任务需要新一类宇航员

美国启动太空计划的早年间多是惊心动魄的试飞和单人轨道任务，这要求宇航员具备无比的自信、无畏的勇气和无情的冷静等特质。或者不太客气地说，就是要“自恋、傲慢和冷漠”。这是美国国家航空航天局（NASA）首批员工心理医生之一帕特丽夏·桑蒂（Patricia Santy）在她的《挑选太空先锋》（Choosing the Right Stuff）一书中做出的评价。

不过，随着太空计划日益成熟，宇航员也已成长。而且他们也不断适应新的任务。下一个巨大飞跃——前往火星——需要宇航员具备与他们的先辈截然不同的素质。他们不仅要在深太空里生存下来，还要适应共同生活。阿波罗11号花了大约三天时间抵达月球，用两天时间返回。往返火星则可能要在大不过一栋小房子的宇宙飞船里度过一年半时间，而且还可能要在火星上逗留一年。

国际空间站的轮换时间约为六个月，因此许多宇航员已经习惯了长时间执行太空任务。但去火星会有新的困难。空间站的宇航员可以与地面专家实时联系，协助他们处理各种情况。而火星宇航员要向太空深处进发，他们与指挥中心的通讯延迟将增加到20分钟或更久；宇航员必须在没有外部支持的情况下合作解决不可预见的问题。

位于伊利诺斯州的西北大学的行为科学家努希尔·康卡特（Noshir Contractor）帮助NASA加强宇航员在太空中的合作。他表示：“毫无疑问，肯定会有一些冲突。”他认为诀窍不在于避免冲突，而是管控冲突。

建造宇宙飞船时，工程师会先在计算机上设计，以便考虑到每一个变量，并了解飞船在不同情境下的行为表现。NASA也在尝试用类似的方法来组建宇航员团队。它的研究人员正在创建计算机模型，模拟不同的人共处在狭小空间里的互动模式，并利用这些模型来预测长期任务中可能发生的冲

突以及优化合作表现。

人比宇宙飞船更复杂。但康卡特把他的工作比作天气预报。天气是气温、气压和风速等各种因素之间复杂而非线性的相互作用的结果。然而模型已经能够可靠地预测下周的气温和降雨概率。气象学家在1950年代开始使用计算机，社会科学家从十年前开始用计算机模拟“人为因素”。

有效的计算机模型需要大量数据，因此NASA设法创造了数据来源。在得克萨斯州休斯顿的约翰逊航天中心的220号楼里，有一个三层楼高、14米长的结构，它包含两个直立的圆柱体，并由第三个圆柱体将它们横向连接在一起。这是一个名为“人类探索研究模拟舱”（Human Exploration Research Analogue，简称HERA）的实验室，宇航员在这里模拟几天到几个月的太空任务。他们只能在实验室里活动，吃太空食物，遵循精确到每分钟的任务和训练安排。在摄像机和麦克风的日夜监控下，他们不断受到生理和心理上的刺激。振动、音效，以及与一个模拟指挥中心之间的通讯延迟增添了真实感和压力感。康卡特将HERA称为“终极人类培养皿”。

待在HERA里的团队成员无处抱怨自己的同事，只能一起工作、生活、吃饭和解决问题。在一项实验中，四名宇航员参加了对一颗名为Geographos的小行星为期30天的模拟探测任务，他们要采集岩石样本并模拟太空行走。他们与地球的单向通讯延迟长达5分钟之久，还一度连续24小时不能睡觉。

那么这些模型和实验揭示了什么呢？团队内部发生冲突并不总是一件坏事。快乐的团队未必是最有成效的。“要说因果关系的话，把这句话改成‘一个有成效的团队才是快乐的团队’会更有说服力。”西北大学的心理学家莱斯利·德彻奇（Leslie DeChurch）说。“没有什么比卓越表现更能够凝聚团队。”

避免冲突可能会扼杀创造性的碰撞，错失产生新的或更好的想法的机会。因任务而产生的冲突与性格上的冲突不同。思想上的交锋可以是有益的。但如果对人不对事，冲突就会变得很难看。

无论是队长还是队员，心理学家寻找那些能够读懂别人对自己看法的人——这可以称为“自我监控”。例如，那些善于自我监控的人通常能分辨出自己是否过于咄咄逼人，导致别人不敢出声，然后会设法让他们放松下来。事实证明，大家都喜欢与这类人共事。

心理学家也衡量宇航员的敬业度。这听起来像是火星之旅必不可少的关键素质。但平均而言，现在被选中在HERA执行任务的宇航员在这方面的得分只在中等水平。

HERA的研究表明，在认真负责这一点上得分非常高的人更可能被其他人视为一种妨碍。其他人可能觉得这个敬业的人总在唠叨。一种优秀的个性是既有一定程度的责任心，又有很强的自我监控力。这样的人会批评其他人的工作但不会越界——而每个成员划出的界线可能各不相同。

成功的太空任务团队需要不断微调。不可能派出一支完美的队伍，然后指望他们在多年内一直保持这种状态。在对HERA的受试者不断测试的过程中，研究人员发现，团队的某些技能往往会在任务中途退步，例如创造性思维和解决问题的能力。这是为什么？也许是因为在一个低刺激的环境里生活，每天吃着同样的食物，看着同样的人，望着同样的黑暗虚空。明白了团队的表现是动态的——不管一开始有多么完美——火星任务的宇航员将必须设法不断激发彼此的想象力。

在HERA实验的基础上，NASA认为它现在可以将候选宇航员的体格、智力和性格特征输入到模型中，预测出在一项任务中谁和谁将发生冲突，准确率能达到75%。

有了这些信息，康卡特的团队正试图找到缓解问题的方法，包括微调队员拿到的“剧本”。“剧本”是一个精确到小时的日程表，详细列出了任务细节，包括谁在何时与谁一起工作。比如说，如果模型显示成员A和B将在第10天发生冲突，研究人员就可以调整当天的剧本，让A和C搭档。或者可以将要执行的任务调整为一个A和B都极为擅长的工作：成就可以培养友情。第三种方案是把A、B和D放在一组，D与前两人都合得来，能从中调解和

修复他俩的关系。如康卡特所说，重组队员就可以修复团队。

| 无处躲藏

说到和同一群人长时间待在狭小空间里这桩事，你应该会觉得似曾相识，寒意来袭。太空计划的一些经验教训或许也适用于疫情期间的地面生活。

首先是要有规律，不仅是安排工作，做饭或休息也一样。例行计划可以带来结构性，这是执行太空任务的核心。HERA的剧本精确地告诉宇航员每小时要做什么，包括工作、吃饭和娱乐。

同时，良好的沟通能力和适应能力也至关重要。1973年12月28日，美国第一个空间站天空实验室（Skylab）的三名宇航员宣布“怠工”，切断了与地面指挥中心的联系，拒绝执行分配给他们的任务。他们因工作量过大而感到沮丧，互相抱怨，但却没有向地面的同事透露不满。

在对太空和地面的团队动态研究中，NASA获得的最重要见解或许是有一个特质尤其可贵：幽默感。对在南极越冬的队员的研究表明，困居一地的团队需要有人扮演各种角色，包括领袖、说书人和社交秘书。但最最重要的角色是小丑，这个人即风趣又足够聪明，能理解团队的每个成员，缓解紧张关系。在探索火星的漫漫旅途中，欢笑将和勇气一样支撑宇航员勇往直前。

插图：帕特里克·莱格 ■



All at sea

Why supply-chain snarls still entangle the world

Shipping delays show little sign of easing

FATHER CHRISTMAS and the global container-shipping industry have similar objectives, though the timescales differ. Santa's world-spanning logistics operation aims to deliver presents all in one night. Shipping firms step theirs up around September to ensure that gifts and other seasonal goods join a vast global supply chain. But a system that usually operates unnoticed (and unremarked upon) is still in chaos. For months a covid-induced maelstrom of delays and sky-high shipping rates has left goods lingering at sea and shop shelves bare around the world. Politicians insist that the snarls will disappear. But survey the horizon and there is little sign of smoother sailing.

The pandemic has hit shipping firms' operations along the supply chain. Labour shortages have been worsened by workers forced to isolate. China's zero-tolerance measures have closed port terminals after the discovery of one or two covid-19 cases. The spread there of the new Omicron variant makes more closures likely. But the most significant impact of the pandemic has been to ignite demand for goods from self-isolating shoppers, particularly Americans eager to buy Chinese products using stimulus money. The value of merchandise goods exported from China to America was 5% greater in the first six months of 2021 compared with 2019, before the pandemic. In September and October it was 19% higher than two years earlier.

The result is that shipping rates are not coming back to earth. A set of benchmark spot rates from Freightos, a digital freight marketplace, between China and America's west coast are below a recent peak. But at around \$15,000 per FEU (40-foot equivalent unit), they are ten times pre-

pandemic levels (see chart 1). The outsize appetite for goods in America has had a knock-on effect elsewhere. A shortage of vessels, drawn by high rates to the trans pacific routes, has pushed the cost of sending boxes between China and Europe to record levels. That raises costs for businesses that rely on shipping firms. Small items such as smartphones or sports shoes can be packed by the tens of thousands into a container. But a rough estimate of the average value of goods in a box travelling between China and America is around \$50,000. Another \$15,000 makes a significant difference.

To eye-watering costs add lengthy delays. Ports, unused to such volumes of traffic, face long queues of ships waiting weeks to unload. In a system already stretched to the limit by lack of lorry drivers and warehouse space, up to 15% of the global container fleet is currently sitting at anchor outside the world's ports.

Apparent signs of improvement are illusory. A widely watched indicator, the armada waiting to offload goods at the twin ports of Los Angeles and Long Beach, America's main entry points for Chinese imports, now numbers some 30-40 vessels, down from 70-80 in October. However, that is mostly because a recent change to the queuing system means that ships are now asked to wait far out at sea (some even linger off the Chinese coast). The real queue is over 100 ships.

Relief from this congestion does not look imminent, and the longer it builds the longer it will take to unwind. Most pundits see little hope of improvement until after Chinese new year in February. Disruptions may last all of 2022. Though rates may have hit a peak, they are unlikely to fall much in the next six months and are set to remain elevated into 2023, thinks Lars Jensen of Vespucci Maritime, a consultancy. Only then will new vessels ordered in response to high rates start to hit the waves.

Even if spot rates have peaked most customers will face higher bills in

2022. The long-term contracts that govern the bulk of container traffic are currently far lower than spot rates—perhaps \$2,500-3,000 per FEU between China and America. But as David Kerstens of Jefferies, a bank, points out, spot rates inform contract rates. In 2021 two-thirds of the contracts signed by Maersk, the world’s biggest container-shipping firm, which controls a fifth of the global market, have been long-term ones. As Maersk’s contracts and those of its rivals roll over, the rates could double. And with customers more concerned about securing scarce capacity than haggling over price, some are signing contracts for two years rather than one.

Fears that a trend for “near-shoring” might hit demand seem unwarranted for now. Soren Skou, boss of Maersk, sees little evidence of it so far. Many firms that source supplies from China are having doubts about relying on one country. A “China plus one” policy of adding a supplier in another part of Asia, such as Vietnam or Thailand, needs more ships to transport these goods directly to America or to giant Chinese hub ports for their onward trip.

The industry’s response to the crunch reflects changes to its structure that predate covid-19. In the words of Rahul Kapoor of the Journal of Commerce, a sectoral must-read, “The era of cheap shipping is behind us.” Shifting goods around the world has been inexpensive because the response to high rates has historically been a frenzy of orders. That, in turn, has led to a flood of vessels that arrive just as economic conditions worsen and trade slows.

But bloody price wars over market share may be gone for good. Since 2016, when a previous ship-ordering binge collided with slowing trade, collapsing rates and big losses, the industry has consolidated—20 big firms have become seven bigger ones in three global alliances. This has helped them manage capacity more ruthlessly. As a result, the cyclical industry may suffer shallower and shorter downturns, says Parash Jain of HSBC,

another bank.

The strange result of the pandemic is that the industry is awash with cash. Simon Heaney of Drewry, a consultancy, says that profits could reach \$200bn in 2021 and \$150bn in 2022, an unimaginable bonanza beside the cumulative total of around \$110bn for the previous 20 years. As well as returning cash to shareholders, Maersk may acquire more firms in e-commerce fulfilment and air-freight as part of its effort to build an end-to-end logistics business that ferries goods by sea, land and air, taking on DHL and FedEx. Other big container-shipping companies such as China's COSCO and France's CMA-CGM are doing the same.

The big question is how much new capacity is in the offing. As world trade boomed in the years before the financial crisis of 2007-09, order books were roughly equivalent to 60% of the existing fleet. They now stand at a little over 20%. Restraint is due in part to uncertainty over the technology needed to make vessels which have a 25-year lifespan compliant with tougher carbon-emissions rules that the industry is expecting. Still, capital discipline may have its limits. Orders have begun to swell again (see chart 2). But it will take two to three years before ships ordered today start rolling down slipways. The era of pricey shipping could well last for another Christmas or two. ■



沧海茫茫

为什么世界仍深受供应链阻塞的困扰

航运延误几乎没有缓解的迹象

圣诞老人和全球集装箱航运业有着相似的目标，只不过工作时间表不同。圣诞老人的全球物流业务是要在一夜之间派送所有礼物。而航运公司则在每年9月左右加大运力，以确保各种礼物和其他节令商品进入庞大的全球供应链。但这个通常不起眼（也很少被评述）的系统目前仍陷于一团混乱中。新冠疫情引发的交付延误和运费飞涨已经持续多月，导致许多货物滞留海上，世界各地的商店货架上却空空如也。政客们坚称这种阻塞会消失。但放眼望去，几乎没有迹象显示航运正在变得顺畅起来。

新冠疫情冲击了航运公司在整个供应链上的运作。工人被强制隔离加剧了劳动力短缺。中国采取零容忍的防疫措施，曾在发现一两例感染病例后就关闭了数个港口码头。新毒株奥密克戎在中国的传播很可能导致更多的码头关闭。但疫情最大的影响是激发了自我隔离中的顾客的购买欲，尤其是那些渴望用经济刺激支票购买中国货的美国人。与疫情爆发前的2019年相比，2021年前六个月中国对美国出口的商品价值增长了5%。而在今年的9月和10月，这一数字比两年前高出19%。

其结果是运费尚未向常态回归。根据数字货运市场Freightos的数据，中国和美国西海岸之间的一组基准现货价格低于不久前的峰值，但仍为每个40英尺集装箱（即一个FEU）1.5万美元左右，是疫情前水平的10倍（见图表1）。美国对商品的巨大需求已经在其他地方引起了连锁反应。船舶都被调至高运费的跨太平洋航线，中国和欧洲之间的集装箱运输成本继而因船舶数量不足而被推到历史最高水平。那些依赖海运的企业的成本也随之上漲。尽管一个集装箱可以塞进成千上万件像智能手机或运动鞋这样的小商品，但据粗略估计，中美之间运输的一个集装箱的平均货值约为五万美元。加上1.5万美元的运费非同小可。

除了令人咋舌的高运费，还有长时间的延误。港口没有应付过如此大的运

输量，排起长队的船舶需要等待数周才能卸货。由于卡车司机和仓储空间短缺，系统本就已经达到极限，目前全球有多达15%的集装箱货船停滞在世界各地的港口之外。

貌似好转的迹象只是一种幻觉。洛杉矶和长滩是中国进口商品在美国的主要入境点，在这两个港口等待卸货的船舶数量是一个广受关注的指标，该指标从10月的70至80艘下降到现在的30至40艘。然而，这主要是因为不久前排队系统做了更改，要求船舶在远离港口的海上等待（现在一些船甚至仍在中国海岸附近逗留）。实际排队的船舶数量超过了一百艘。

这样的拥堵看起来不会很快缓解，而且拥堵持续的时间越长，缓解所需的时间也就越长。大多数专家认为在2月的中国春节过完前都没有什么改善的希望。混乱可能会持续整个2022年。韦斯普奇海事咨询公司（Vespucci Maritime）的拉尔斯·延森（Lars Jensen）认为，尽管运费可能已经达到峰值，但在接下来的六个月里不太可能大幅下降，而且应该会一路高企着进入2023年。只有到那时，为应对高运费而订购的新船才会开始启航。

即使现货价格已经见顶，大多数客户在2022年还是会面对更高额的账单。集装箱运输大部分签订的都是长期合约，其价格目前远低于现货价格——中美之间的合约运价大约是每个FEU2500至3000美元。但正如投资银行杰富瑞（Jefferies）的大卫·克斯滕（David Kerstens）指出的，现货价格影响着合约价格。全球最大的集装箱航运公司马士基（Maersk）控制着全球五分之一的市场，该公司在2021年签订的合约有三分之二都是长期合约。随着马士基及其竞争对手的合约开始续期，运费可能会翻倍。而由于客户更关心的是锁定稀缺的运力而不是讨价还价，一些客户开始签订为期两年而不是一年的合约。

有人担心“近岸外包”的趋势可能影响海运需求，这种担心在目前看来似乎没什么必要。马士基的老板施索仁（Soren Skou）表示到目前为止还看不到相关证据。许多从中国采购商品的公司开始对依赖单个国家心生疑虑。“中国加一国”的策略——也就是在亚洲其他地区增加一个供应国，如越南或泰国——需要更多的船舶把这些货物直接运到美国或者先运到中国的大

型枢纽港口再转运。

航运业对运力短缺的反应体现出早在疫情前就已发生的结构变化。用行业权威刊物《商业期刊》（Journal of Commerce）的拉胡尔·卡普尔（Rahul Kapoor）的话来说就是“廉价航运的时代已经过去了。”过去全球货物运输一直不是太昂贵，原因是一旦运费升高大家就开始大量订购新船。而等到一大批新船交付之时，经济却已开始下滑，贸易放缓了。

但争夺市场份额的残酷价格战可能一去不复返了。发生在2016年的上一次船舶订购潮撞上了贸易放缓、运费暴跌，导致巨额亏损，此后航运业开始了整合——20家大公司变成了七家更大的公司，分属三大全球联盟。这让它们在运力管理上也更加严苛。结果就是这个周期性行业的衰退期可能变得不那么深重，也更短暂了，汇丰银行的帕拉什·贾因（Parash Jain）表示。

疫情导致的奇怪结果是航运业赚了个盆满钵满。咨询公司德鲁里（Drewry）的西蒙·希尼（Simon Heaney）表示，2021年该行业的利润可能达到2000亿美元，2022年达到1500亿美元，与之前20年累计约1100亿美元的总利润相比，这是难以想象的巨额财富。除了给股东们分红，马士基还可能收购更多电商履约和空运公司，帮助它建立端到端物流业务，海运、陆运和空运多头并举，与DHL和联邦快递展开竞争。其他大型集装箱航运公司，如中国的中远集团和法国的达飞海运集团（CMA-CGM），也在做同样的扩张。

即将新增多少运力是个大问号。在2007至2009年金融危机之前的几年里，全球贸易蓬勃发展，货船的订单量大约相当于当时已有船舶的60%。目前这一比例略高于20%。制约因素之一是，要制造出25年使用年限但又符合该行业预期会出台的更严格排放规定的船舶，所需的技术还不确定。不过，资本纪律的约束可能也有限。订单量已经开始再度增加（见图表2）。但眼下订购的船舶还需要两到三年的时间才能下水。高价航运的时代很可能持续到下一个或下下个圣诞节。■



A bloodless revolution

Meatless meat is nothing new

But it is getting tastier and more popular

ONE NOZZLE moves back and forth piping red goo into a rectangle. Another follows adding white layers of a similar substance. The nozzles are labelled “muscle” and “fat”. A third, marked “blood”, works alongside them. They are part of a machine, developed by Redefine Meat, an Israeli startup, that can print a steak made entirely of plant-based ingredients.

This method may seem like something out of science fiction, but what it produces has a long history. For hundreds of years humans have sought alternatives to animal milks and meats because they were scarce and expensive.

During the Tang dynasty (618-907 AD), cheese was increasingly brought from Europe and India to China. Little dairy milk was available so the Chinese used the same method as Western cheese makers but substituted soya milk for cows’ milk to create their own “bean cheese”: tofu. During the late 19th century this gained, if not popularity, at least a certain acceptance in the West.

But in America the expansion of the railways, commercial refrigeration and intensive farming made meat cheaper and more readily available from the 1880s. One man was convinced this was a mistake. In 1896 John Kellogg, breakfast revolutionary, started to sell “Nuttose”. Around three years later he followed that with “Protose”, concocted from peanuts and wheat gluten. Both were marketed as the “perfect substitute for flesh food”.

Kellogg’s meat substitutes did not catch on, perhaps because canned, room-temperature, nut-flavoured slurries are not terribly appealing. Today others

are proving more popular. Over 1,000 different plant-based meat products are available in America according to data from Instacart, a food-delivery company. Almond milk—which records suggest was first used in Europe during Lent in the 13th century—and its newer competitor, oat milk, are both growing in popularity. Between 2019 and 2020 total sales of plant-based food in America increased by 27%, to \$7bn.

Plant-based food sales are expected to rise even further in part because of concerns about the environmental impact of the world's diet. The global food system currently accounts for 21-37% of human emissions. The OECD, a club of mostly rich countries, reckons that growing, wealthier populations in developing countries will mean a 14% rise in global meat consumption by 2030.

Some in the rich world are reducing their meat consumption. Nearly one-third of Americans said they had eaten less meat in the past year compared with the year before, according to a recent survey from YouGov, a big cheese in the world of polling, many for environmental reasons.

Flexitarianism—eating less meat rather than refraining from it entirely—will probably drive demand for meat-free products more than strict veganism, especially if companies succeed in producing steaks and pork chops in labs, without any involvement from animals. Those who insist on sticking to a meaty diet could end up looking pig ignorant.

ILLUSTRATIONS: MANUEL BORTOLETTI ■



不流血的革命

没有肉的肉不是什么新鲜事物

但它越来越好吃，越来越受欢迎

一个喷嘴来回移动，喷出的红色粘稠物形成一个长方形。另一个喷嘴跟上，往上添加几层白色的类似物质。这两个喷嘴上分别标着“瘦肉”和“脂肪”。还有个跟它们一同工作的喷嘴标着“血”。这些都是以色列创业公司Redefine Meat研发的一种机器的一部分，可以打印完全由植物成分制成的牛排。

这种方法也许看起来像是科幻小说里的东西，但生产出来的产品却历史悠久。上千年来，人类一直在寻找动物奶和肉的替代品，因为它们稀缺又昂贵。

唐朝（公元618-907年）时期，越来越多的奶酪从欧洲和印度传入中国。当时牛奶不易得，所以中国人把西方奶酪制造商的方法拿来，但用豆奶代替牛奶，创造出了他们自己的“豆奶酪”：豆腐。19世纪末期，豆腐在西方即便没有普及，也至少开始被一部分人接受。

但在美国，铁路扩张、商用制冷和集约化养殖让肉类从19世纪80年代开始变得更便宜，也更容易获得。有个人深信这是一个错误。1896年，早餐革命家约翰·家乐氏（John Kellogg）开始销售“Nuttose”（坚果糖）。大约三年后，他又用花生和麦麸调制出“Protose”。二者都以“肉类食品的完美替代品”的名头来推销。

家乐氏的肉类替代品并没有流行起来，也许是因为罐装的常温坚果味稀汤不是特别吸引人。今天，别家的肉类替代品已经变得更普及了。根据食品配送公司Instacart的数据，美国有1000多种各式各样的植物基肉类产品。据记载，杏仁奶最早出现在13世纪欧洲的大斋节期间，现在它和更晚出现的对手燕麦奶都越来越受欢迎。2019年至2020年间，美国植物基食品的总销售额增长了27%，达到70亿美元。

植物基食品的销售预计会进一步增长，部分原因是饮食影响环境的担忧。全球食物系统的排放目前占人类总排放量的21%到37%。成员主要是富裕国家的经合组织（OECD）认为，发展中国家不断增长且富裕起来的人口意味着到2030年全球肉类消费将增长14%。

富裕国家的一些人正在减少肉类消费。知名调研机构YouGov最近的一项调查显示，近三分之一的美国人表示他们在过去一年中吃的肉比前一年少，很多人是出于对环境的关切。弹性素食——少吃肉而非完全不吃肉——可能比严格的纯素食主义更能推动对无肉产品的需求，尤其是如果企业能在实验室成功生产出牛排和猪排而不涉及任何动物的话。那些坚持无肉不欢的人最终可能被世人鄙夷为“猪脑袋”。

插图：曼努埃尔·波托莱蒂 ■



Follow the money

After a shocker in 2021, where might inflation go in 2022?

We chart two alternative paths

THE ONLY thing that proved transitory about inflation in America in 2021 was the consensus that it would subside. The upper chart shows that analysts consistently revised up their predictions, trailing reality. Consumer prices are now rising by nearly 7% compared with a year earlier, the fastest pace since 1982. What does the future hold? The lower chart presents two scenarios. In the first, month-on-month inflation immediately falls back to its pre-pandemic trajectory. Even so, it would take until the end of 2022 for annual inflation to slow to the 2% pace that used to be the norm. In the second case, consumer prices rise at the same monthly clip seen over the past year. Annual inflation would soar to nearly 8% in February, and stay elevated. Either way, one prediction seems rock-solid: the Federal Reserve will start raising interest rates in 2022, as the central bank itself indicated on December 15th. ■



跟着钱走

继2021年的惊人上涨之后，通胀在2022年可能走向何方？

我们绘制了两条路线

关于美国2021年的通胀，唯一很快消退了的是认为它会消退的共识。从上部图表可见，分析师不断跟随现实通胀上调自己的预测。与去年同期相比，消费者物价上涨了近7%，是1982年以来的最快增速。未来会怎样？下部图表展示了两种可能情境。第一种情况下，月通胀率会迅速回落到疫情前的轨道上。即便如此，年通胀率也要到2022年底才能降到2%的既往常态。第二种情况下，消费者物价保持过去一年里的月增幅。到2月，年通胀率将涨至接近8%，并保持在高位。不管哪一种，有一个预测似乎已是板上钉钉：美联储将在2022年开始加息，正如它自己在12月15日暗示的那样。■



Marine propulsion

Nature does not use propellers. So why do people?

Real fintech

NO KNOWN SEA-CREATURE uses propellers. Perhaps that is because they are too difficult to evolve from existing animal body plans. Or perhaps it is because they are not particularly good at doing what they do. When pushing water around for propulsive purposes, bigger is not only more powerful but also more efficient. But the bigger a propeller is, the harder it is to accommodate to a hull and the more it risks adding to a ship's draft and thus snagging the seabed. Even the biggest ships' propellers are therefore only around ten metres in diameter.

Fins and flippers, by contrast, extend sideways, so do not suffer from such geometric restrictions. That means they can get big enough to push a lot more water around. Nor, unlike propellers, need they be rigid. In fact, being flexible is almost part of the definition (a rigid fin might better be described as an oar). They are therefore not easily damaged by contact with the seabed or other objects. Fins have thus become evolution's go-to accoutrement for marine propulsion. From fish, via ichthyosaurs, to dolphins and whales, they turn up again and again. So, from plesiosaurs and turtles to seals and penguins, do their cousins, flippers.

In light of this evolutionary vote of confidence in fins, ships' propellers look like a technology ripe for a bit of biomimetic disruption. And that may now have arrived in the shape of Benjamin Pietro Filardo, an ex-marine biologist and architect who was looking into ways of designing devices to extract power from water currents. His plan was to use flexible materials, so that they could easily shake off any debris which got entangled in them. He then realised that the undulations involved might also usefully be turned into thrust.

Mr Filardo has put his money where his mouth is. His firm, Pliant Energy Systems, based in New York, has developed Velox (pictured), a prototype propelled by flexible fins, port and starboard, that are reminiscent of yet another animal's approach to swimming—the undulating mantle of a cuttlefish. Velox can travel on the surface, underwater, and also across mud or ice, with its fins then acting in the manner of a pair of robotic caterpillars.

According to Mr Filardo, Velox produces around three times as much thrust per unit of energy expended as a typical small boat's propeller can manage. And he hopes, soon, to do even better than this. Having demonstrated his device to America's Office of Naval Research, he has piqued their interest. The result is a commission for a follow-up, C-Ray, that should be lighter, faster and yet more efficient.

Unlike Velox, which is controlled by cable, C-Ray will be autonomous—the ultimate aim being to develop co-operative swarms of craft for jobs such as mine detection and removal, reconnaissance and anti-submarine patrols. From a naval perspective, however, undulatory propulsion may have a yet-more-important advantage. Submarines are often detected by the noise they make, much of which comes from the propeller and the shaft driving it. Undulatory propulsion, moving more water at lower speed, should be quieter than any propeller. Nor does it involve a noisy phenomenon called cavitation, caused by transient gas bubbles that form in response to propeller blades' pressure.

This matters, because Velox-like fins may prove to be a technology that can be scaled up to propel full-sized submarines. As Mr Filardo observes, the largest marine animals of all, the great whales, are fin-propelled, even if their fins are arranged differently from Velox's. Indeed, the biggest of the lot, a blue whale, can travel at more than 20 knots, which would not disgrace the average submarine. Previous attempts to scale-up fin-

propulsion have failed, he says, because they have not found the necessary compromise between stiffness and flexibility. He reckons he has.

| *Travelling waves*

Even if they do not make the big-time, naval-warfare-wise, swarms of Velox's descendants might be deployed for tasks from harvesting scallops without destructive trawling to mining nodules from the seabed without harming habitats—for undulatory propulsion does not disturb sediment. In a world where the creation of new carbon sinks may become big business, they might even be used to plant beds of seagrass on a vast scale. Craft propelled by undulation would also have less risk of harming swimming mammals, such as manatees and human beings, which sometimes get chewed up by propellers.

Mr Filardo is even looking into the idea of merging his interests, by designing a craft with undulating propulsion that can moor itself and then recharge its batteries from disturbances to its fins caused by passing ocean currents. Just how far he or others will be able to push this new approach to propulsion remains to be seen. But if the engineering works, and can indeed be scaled up, ship's propellers may one day look as old-fashioned as sails. ■



船舶推进

大自然不用螺旋桨。那人类为何要用？

新“鳍”科技

没有任何已知的海洋生物使用类似螺旋桨的构造。这也许是因为从现有的动物身体构造中很难进化出这种部件。也可能是因为螺旋桨对自己干的活也不算特别擅长。当为了向前推进而推动水时，螺旋桨的尺寸更大不仅力道更大，也更高效。但是，螺旋桨越大，就越难与船体适配，也更容易增加船的吃水，导致船沉陷在海床上。因此，即便是最大的船舶，螺旋桨的直径也只有10米左右。

相比之下，鳍和鳍状肢会侧向伸展，所以不受这种几何形状的限制。这意味着它们可以长得足够大，向四周推动更多的水。它们也不需要像螺旋桨那样坚硬。事实上，柔韧性几乎是其定义的一部分（坚硬的鳍可能还是称作桨更合适）。因此，它们不易因碰触海床或其他物体而受损。于是，鳍已进化为在海洋中获取推动力的首选“装备”。从鱼、鱼龙，到海豚和鲸鱼，鳍屡屡出现。鳍的表亲鳍状肢也一样，从蛇颈龙和海龟到海豹和企鹅，都能见到这种构造。

鉴于进化对鳍投出的信任票，如今看来时机已经成熟，可以让船舶螺旋桨这项技术经受一点仿生学上的颠覆了。而颠覆者现在可能已经降临，他就是前海洋生物学家和建筑师本杰明·皮埃特罗·费拉尔多（Benjamin Pietro Filardo），他正在研究如何设计出从水流中获取动力的设备。他计划使用柔韧的材料，可以更轻松地甩掉卷入设备中的任何杂物。他随后意识到，过程中的波浪起伏或许也可以有效地转化为推力。

费拉尔已经付诸实践。他位于纽约的公司“柔顺能源系统”（Pliant Energy Systems）开发出了一款名为Velox（如图）的原型机，由充当左右舷的柔性鳍状物推动，它们让人想起另一种动物的游泳方式——乌贼波状起伏的外套膜。Velox可以在水面和水下行进，也能穿越泥地和冰面——这时它的鳍发挥了一对机器人履带的作用。

据费拉尔多说，Velox每消耗一个单位能量所产生的推力大约是一艘典型小船的螺旋桨能达到的三倍。他希望很快还能进一步优化。他向美国海军研究办公室演示了这套装置，成功引起了对方的兴趣。他受委托研发下一代原型C-Ray，它应该会更轻、更快、更高效。

与受电缆控制的Velox不同，C-Ray会有自主性——最终目的是开发出协同工作的舰队，用于探雷排雷、侦察和反潜巡逻等工作。然而，从海军的角度看，起伏推进可能有一个更重要的优势。潜艇经常因发出的噪音被侦测到，而噪音多来自螺旋桨及其驱动轴。起伏推进以更慢的速度推动更多的水，应该比任何螺旋桨都更安静。它也不会产生一种名为气穴的噪音现象，这种现象由在螺旋桨叶片的压力下形成的瞬时气泡引起。

这一点很重要，因为类似Velox的鳍的相关技术也许可以进一步拓展，用于驱动全尺寸的潜艇。正如费拉尔多所观察到的，最大的海洋动物大鲸鱼也是用鳍推进的，虽然它们的鳍的排列方式与Velox的不同。实际上，其中最大的蓝鲸能以超过20节的速度遨游，这倒不会让普通潜艇蒙羞。他说，过去扩展鳍推进技术的尝试失败了，原因是没能在硬度和柔韧性之间找到必要的折中方案。他认为自己已经找到了。

| 行进波

即使不能在海战中大显身手，大群的Velox衍生物也可能被用来执行各种任务，比如不用拖网捕捞扇贝从而避免破坏海底环境，又比如开采海底的结核而不损害生物栖息地——因为起伏的推进力不会搅动沉积物。随着创造新碳汇可能成为一门大生意，它们甚至可能被用来大规模种植海草床。靠起伏获得推力的船只也会降低伤害游动的哺乳动物的风险，如海牛和人类，他们有时会被螺旋桨绞伤。

费拉尔多甚至在考虑把自己的多种兴趣融合起来，设计一艘具有起伏推进力的船，可以自行停泊，随后还能利用经过的洋流对自己鳍的干扰来给电池充电。费拉尔多或其他人能把这种新的推进方式推进多远，还需拭目以待。但如果工程设计可行又确实可以实现规模化，那么有朝一日船舶的螺旋桨看起来可能会像船帆一样过时。■